

SCIENCE AND SCIENCE FICTION

VOL. 1



An artist's rendition of the Phoenix Mars probe during landing. NASA, 2007.

A STORY FROM AUDUBON, by Jean-Henri Fabre

CONSERVATION, BY Charles L. Fontenay

LECTURE IV., THE FORCE OF GRAVITY, by Robert Stawell Ball

4-1/2B, EROS, By Malcolm Jameson

SPACECRAFT STERILIZATION, by NASA

MOVING THE MOUNTAIN, Ch. 1 & 2, by Charlotte Perkins Gilman

PHYSICAL GEOGRAPHY, Ch. 2, by Mary Somerville

A WORLD IS BORN, by Leigh Brackett

A STORY FROM AUDUBON

The Project Gutenberg eBook #67073 of
Our Humble Helpers, by Jean-Henri Fabre

“Here is what we are told on this subject by the celebrated ornithologist, Audubon, whom I have already quoted in describing to you the habits of the turkey as it is found in its free state in the great forests of its native land.

“The passenger pigeon, or, as it is usually named in America, the wild pigeon, moves with extreme rapidity, propelling itself by quickly repeated flaps of the wing, which it brings more or less near the body, according to the degree of velocity which is required....

“This great power of flight is seconded by as great a power of vision, which enables them, as they travel at that swift rate, to inspect the country below, discover their food with facility, and thus obtain the object for which their journey has been undertaken. This I have also proved to be the case, by having observed them, when passing over a sterile part of the country, or one scantily furnished with food suited to them, keep high in the air, flying with an extended front, so as to enable them to survey hundreds of acres at once. On the contrary, when the land is richly covered with food, or the trees abundantly hung with mast, they fly low, in order to discover the part most plentifully supplied....

“The multitudes of wild pigeons in our woods are astonishing. Indeed, after having viewed them so often, and under so many circumstances, I even now feel inclined to pause, and assure myself that what I am going to relate is fact. Yet I have seen it all, and that too in the company of persons who, like myself, were struck with amazement.

“In the autumn of 1813, I left my house at Henderson, on the banks of the Ohio, on my way to Louisville. In passing over the Barrens a few miles beyond Hardensburgh, I observed the pigeons flying from northeast to southwest, in greater number than I thought I had ever seen them before, and feeling an inclination to count the flocks that might pass within the reach of my eye in one hour, I dismounted, seated myself on an eminence, and began to mark with my pencil, making a dot for every flock that passed. In a short time finding the task which I had undertaken impracticable, as the birds poured in in countless multitudes, I rose, and counting the dots then put down, found that one

hundred and sixty-three had been made in twenty-one minutes. I traveled on, and still met more the farther I proceeded. The air was literally filled with pigeons; the light of noonday was obscured as by an eclipse; the dung fell in spots, not unlike melting flakes of snow; and the continued buzz of wings had a tendency to lull my senses to repose.

“Whilst waiting for dinner at Young’s inn, at the confluence of Salt River with the Ohio, I saw, at my leisure, immense legions still going by, with a front reaching from beyond the Ohio on the west, and the beech-wood forests directly on the east of me. Not a single bird alighted, for not a nut or acorn was that year to be seen in the neighborhood. They consequently flew so high, that different trials to reach them with a capital rifle proved ineffectual; nor did the reports disturb them in the least. I cannot describe to you the extreme beauty of their aerial evolutions, when a hawk chanced to press upon the rear of a flock. At once, like a torrent, and with a noise like thunder, they rushed into a compact mass, pressing upon each other toward the center. In these almost solid masses, they darted forward in undulating and angular lines, descended and swept close over the earth with inconceivable velocity, mounted perpendicularly so as to resemble a vast column, and, when high, were seen wheeling and twisting within their continued lines, which then resembled the coils of a gigantic serpent.

“Before sunset I reached Louisville, distant from Hardensburgh fifty-five miles. The pigeons were still passing in undiminished numbers, and continued to do so for three days in succession. The people were all in arms. The banks of the Ohio were crowded with men and boys, incessantly shooting at the pilgrims, which there flew lower as they passed the river. Multitudes were thus destroyed. For a week or more, the population fed on no other flesh than that of pigeons, and talked of nothing but pigeons. The atmosphere, during this time, was strongly impregnated with the peculiar odor which emanates from the species....

“It may not, perhaps, be out of place to attempt an estimate of the number of pigeons contained in one of those mighty flocks, and of the quantity of food daily consumed by its members.... Let us take a column of one mile in breadth, which is far below the average size, and suppose it passing over us without interruption for three hours, at the rate mentioned above of one mile in the minute. This will give us a parallelogram of 180 miles by 1, covering 180 square miles. Allowing two pigeons to the square yard, we have 1,115,136,000 pigeons in one flock. As every pigeon daily consumes fully half a pint of food, the

quantity necessary for supplying this vast multitude must be 8,712,000 bushels per day.



Lithograph of John James Audubon painting of passenger pigeons.

“As soon as the pigeons discover a sufficiency of food to entice them to alight, they fly round in circles, reviewing the country below. During their evolutions, on such occasions, the dense mass which they form exhibits a beautiful appearance, as it changes its direction, now displaying a glistening sheet of azure, when the backs of the birds come simultaneously into view, and anon suddenly presenting a mass of rich deep purple. They then pass lower, over the woods, and for a moment are lost among the foliage, but again emerge, and are seen gliding aloft. They now alight, but the next moment, as if suddenly alarmed, they take to wing, producing by the flappings of their wings a noise like the roar of distant thunder, and sweep through the forests to see if danger is near. Hunger, however, soon brings them to the ground. When alighted, they are seen industriously throwing up the withered leaves in quest of the fallen mast. The rear ranks are

continually rising, passing over the main body, and alighting in front, in such rapid succession, that the whole flock seems still on wing. The quantity of ground thus swept is astonishing, and so completely has it been cleared that the gleaner who might follow in their rear would find his labor completely lost. While feeding, their avidity is at times so great that in attempting to swallow a large acorn or nut, they are seen gasping for a long while, as if in the agonies of suffocation.

“On such occasions, when the woods are filled with these pigeons, they are killed in immense numbers, although no apparent diminution ensues.... As the sun begins to sink beneath the horizon, they depart en masse for the roosting-place....

“Let us now inspect their place of nightly rendezvous. One of these curious roosting-places, on the banks of the Green River in Kentucky, I repeatedly visited. It was, as is always the case, in a portion of the forest where the trees were of great magnitude, and where there was little underwood.... My first view of it was about a fortnight subsequent to the period when they had made choice of it, and I arrived there nearly two hours before sunset. Few pigeons were then to be seen, but a great number of persons, with horses and wagons, guns and ammunition, had already established themselves on the borders. Two farmers from the vicinity of Russelsville, distant more than a hundred miles, had driven upwards of three hundred hogs to be fattened on the pigeons which were to be slaughtered. Here and there the people employed in plucking and salting what had already been procured, were seen sitting in the midst of large piles of these birds. The dung lay several inches deep, covering the whole extent of the roosting-place, like a bed of snow. Many trees two feet in diameter, I observed, were broken off at no great distance from the ground, and the branches of many of the largest and tallest had given way, as if the forest had been swept by a tornado. Everything proved to me that the number of birds resorting to this part of the forest must be immense beyond conception. As the period of their arrival approached, their foes anxiously prepared to receive them. Some were furnished with iron pots containing sulphur, others with torches of pine knots, many with poles, and the rest with guns. The sun was lost to our view, yet not a pigeon had arrived. Everything was ready, and all eyes were gazing on the clear sky, which appeared in glimpses amidst the tall trees. Suddenly there burst forth a general cry of “Here they come!” The noise which they made, though yet distant, reminded me of a hard gale at sea, passing through the rigging of a close-reefed vessel. As the birds arrived and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the pole-men. The birds continue to

pour in. The fires were lighted, and a magnificent, as well as wonderful and almost terrifying, sight, presented itself. The pigeons, arriving by thousands, alighted everywhere, one above another, until solid masses as large as hogsheads were formed on the branches all round. Here and there the perches gave way under the weight with a crash, and falling to the ground, destroyed hundreds of the birds beneath, forcing down the dense groups with which every stick was loaded. It was a scene of uproar and confusion. I found it quite useless to speak, or even to shout to those persons who were nearest to me. Even the reports of the guns were seldom heard, and I was made aware of the firing only by seeing the shooters reloading.

“No one dared venture within the line of devastation. The hogs had been penned up in due time, the picking up of the dead and wounded being left for the next morning’s employment. The pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. The uproar continued the whole night.... Toward the approach of day, the noise in some measure subsided, long before objects were distinguishable, the pigeons began to move off in a direction quite different from that in which they had arrived the evening before, and at sunrise all that were able to fly had disappeared. The howlings of the wolves now reached our ears, and the foxes, lynxes, cougars, bears, racoons, opossums, and polecats were seen sneaking off, whilst eagles and hawks of different species, accompanied by a crowd of vultures, came to supplant them, and enjoy their share of the spoil.

“It was then that the authors of all this devastation began their entry amongst the dead, the dying, and the mangled. The pigeons were picked up and piled in heaps, until each had as many as he could possibly dispose of, when the hogs were let loose to feed on the remainder.’

“Here ends Audubon’s story. What do you think of it, my friends?”

“I think,” Jules replied, “that those flocks of pigeons darkening the sky and taking several days to pass over are the most astonishing thing I have ever heard of about birds.”

“And I,” said Emile, “am still thinking of that shower of dung that falls from the sky, as thick as flakes of snow in winter, when the pigeons are flying over. Everywhere they fly the ground is whitened with this singular shower.”

“And those trees breaking under the pigeons’ weight,” Louis exclaimed; “those three hundred pigs let loose to surfeit on what the hunters have left—all that would seem incredible to me if Uncle Paul had not assured us it was so.”

“It’s a great pity,” sighed Emile, “that we have no such flocks of pigeons here. If they are knocked down with nothing but a pole, as we knock down apples and nuts, I would undertake to bag a fine lot myself.”

“Would you also,” his uncle asked him, “undertake to find food for the pigeons, when for a single day’s supply for one of their flocks it takes from eight to nine million bushels of seeds? You see well enough that such multitudes would be calamitous: the entire harvest of a province would scarcely be enough to fill the crops of these ravenous birds. Such flocks require vast tracts of woodland not exploited by man, such as America had sixty years ago, in Audubon’s time. But to-day, in that country, as civilization extends its boundaries the primeval forests disappear and give place to cultivated fields. Food becoming scarce, pigeons also become scarce; and it is doubtful whether one could ever again witness such prodigious scenes as formerly.”

[Editor's note: the passenger pigeon became extinct in the early 20th Century.]



CONSERVATION

By Charles L. Fontenay

The people of Earth had every means of power at their command, yet they used none of it. Was it due to lack of knowledge and technique; or was there a more subtle, dangerous reason?

[Transcriber's Note: This Project Gutenberg etext, #60462, was produced from Worlds of If Science Fiction, April 1958.

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The yellow sands of the spaceport stretched, glaring and empty, in every direction. There was no sign of life from the little group of buildings a mile away.

In the control room of the tall, round-nosed starship, technicians labored and officers conferred while the red needles that showed rocket tube temperatures sank slowly toward zero on their dials.

"Maybe Earth's depopulated, Tom," suggested John Gray, the executive officer. He ran his fingers through close-cropped red hair and peered through the port with thoughtful gray eyes.

"Hardly, John," replied Commander Tom Wallace, frowning. "The scout rockets showed some good-sized cities, with smoke."

"I was off duty then and haven't had time to read the log," apologized John. "What gets me is that they should have a robot-controlled space relay station orbiting outside the atmosphere, and a deserted spaceport. It just doesn't jibe."

"That's why we have to be just as careful as though we were landing on an alien planet," said the commander. "We don't know what the conditions on Earth are now. How long has it been, John?"

"Two hundred and fifty-eight years," answered John. "Ten years, our time."

"Pick three for briefing, John. This is going to be a disappointing homecoming for the crew, but we'll have to send out an exploration party."

The landing ramp slid out from just above the rocket tubes, and the armored car clanked down to the sand. John steered it across the wide expanse of the spaceport toward the group of buildings. Above and behind him, a woman swept the terrain with binoculars from the car's observation turret. In the body of the car, another woman and a man stood by the guns.

The buildings were just as lifeless when they drew near, but there was an ominous atmosphere about them. They were windowless, of heavy concrete. Through slits in their domed roofs, the noses of a dozen cannon angled toward the ship.

"John, there's someone there," said the girl in the turret, tensely. "You can't see it through the windshield, but there are some smaller guns poking out near the ground and they're following us."

John stopped the car and switched on the loudspeaker.

"Hello, the spaceport!" His amplified voice boomed out across the sand and reverberated against the buildings. "Is anybody there? We come in peace."

There was no reply. The big guns still angled toward the starship, the little ones focussed on the car.

"They may be robot-controlled," suggested Phil Maxwell, the gunner on the side of the car toward the forts. "Any sign of an entrance, Ann?"

"Nothing but the gunports," replied the girl in the turret.

"Don't fool with them, John," said Commander Wallace, who was tuned in from the ship on the car's communications system. "If they're robot-controlled, they'll be booby-trapped. Move out of range and continue with your exploration."

* * * * *

Two days later, the car emerged from the desert into comparatively fertile country. The four explorers found a broken concrete highway and followed it between rolling, treeless grasslands. Near dusk, they saw smoke on the horizon--and ran into a roadblock.

A segment of the highway had been thrown up into a ten-foot wall, barring their progress. Over the edge of the wall, the muzzles of heat-guns pointed at them as they brought the car to a halt some distance away. John got the commander on the car radio.

"We could swing around it, but we don't know whether they have vehicles that could outrun us," he reported. "And my conception of our mission is to establish contact."

"That's right," agreed Tom. "But stay in the car until you get a friendly reaction. Then you're on your own--and I'm afraid you're expendable, John."

John switched on the loudspeaker and made overtures to the roadblock. After a moment, a lone figure stepped around the edge of the mound of earth and concrete and approached the car slowly. The man was dressed in the drab, baggy uniform of a professional soldier.

"If you come in peace, leave your vehicle and identify yourself," called the soldier. "You will not be harmed."

"Take over, Phil," ordered John. He slipped from the driver's seat and climbed through the turret. Jumping to the ground, he approached the soldier, his arms swinging freely at his sides.

"John Gray, executive officer of the starship Discovery, returned from a colonizing mission to Deneb III," said John, holding out his hand.

The soldier ignored the out-stretched hand, saluting formally instead.

"Arrive in peace," he said. "If you will leave your vehicle here, you will be escorted as deevs to Third Sarge Elfor, commander of the town of Pebbro."

John returned to the car and held a brief consultation with his companions. Although he was in command of the exploration party, planetary operations of the starship's personnel were conducted on a somewhat democratic basis. The commander listened in, but left them to their own judgment.

"Communications blackout for a while then, commander," said John. "I see no reason to let them know about the personal radios right now."

The quartet emerged from the car wearing small packs of emergency rations and equipment. Behind the roadblock, the sight that met their eyes was unexpected.

The robot-controlled space relay station, the heavily armed pillboxes at the spaceport and the heat-guns poked across the roadblock at them, all had made it logical to anticipate a powerfully equipped task force. Instead, they found a troop of 19th century cavalrymen, armed for the most part with 13th century weapons. There were no more than a dozen heat-guns in evidence, and their bearers also carried short swords and long-bows with quivers of arrows.

The four from the starship were given mounts and, with no outward indications of hostility, were escorted to the town whose smoke they had seen.

The town was another surprise. They had expected either a fortress or an outpost of brick and log buildings. It was neither. The buildings were tremendous cubes and domes of steel and concrete, sleek and modern, windowed with heavy glass bricks. Skeins of cables, coils and loops of aerals bespoke the power that must be at their command.

But the people walked.

Not a car or a truck was to be seen. Men and women in the gray military uniforms walked or trotted up and down the broad paved streets. Occasionally a horse-drawn wagon passed, hauling a load of vegetables or manure. It was as though a cavalry post of the old West carried on its slow-moving duties in a super-modern setting.

* * * * *

Third Sarge Elfor was a middle-aged man of military bearing, with a sandy handle-bar mustache. He sat behind a huge desk in one of the town's biggest buildings. There were elevators, open and deserted, in the lobby, but they had to climb ten flights of stairs to reach his gleaming office.

"The Topkick sends you greetings from Kansity, capital of the Earth," he said. "We have watched your ship since it approached the outer atmosphere. We have listened to your communications since you left your ship, and have been interested in the indications that you are of Earth but unfamiliar with it. We are interested also in your use of a vehicle that can travel for three days without refueling. But we do not find a record of any ship named Discovery, and we do not know what you mean by Deneb III."

"The Discovery left Earth 258 years ago," replied John. "We established a colony on Deneb III, the third planet of the star Deneb, before returning to Earth."

"You are the descendents of the ship's original crew, then?"

"No," said John. He explained as well as he could the extension of subjective time at near-light speeds.

"Mmm. And you have left a colony on a planet of another star." They could not tell from the Third Sarge's tone what he thought. After a moment's meditation, he said:

"We shall talk again tomorrow. Tonight you are our guests and will be accorded all courtesy as deevs. Are you husbands and wives, or shall we billet men and women separately?"

"However it suits your convenience," answered John. "You may billet us all together if you prefer."

Third Sarge Elfor took them at their word. They were conducted to a single room, evidently in the heart of officers' quarters. Here again they ran into the same anomaly that had impressed them since they landed.

There were gleaming electric fixtures, but orderlies brought them tallow candles as dusk fell. There was plumbing of the most advanced order, but when they turned the taps no water came. The orderlies

brought buckets full of hot water for their baths in the bright-tiled tub.

"I don't understand this at all, Ann," said John. He was towelling himself vigorously, while she brushed the quartet's clothing clean of the dust of the road. Phil lolled in luxurious undress on one of the four beds, reading a book from the well-stocked bookcase. Fran, preparing for her bath, was binding up her hair before a full-length mirror. "Even the cold water doesn't run a drop."

"Plumbing gets out of order in the best of families, John," Ann reminded him with a smile.

He glanced affectionately at her. Blue-eyed, black-haired Ann had been John's companion in the six-months exploration of Deneb III, and their seven-year-old son now was learning to read in the starship's school. John and Ann clashed like flint and steel in the crowded confines of the starship and consequently maintained no association while aspace. But they were a happy team in the free, challenging atmosphere of a planet.

"Electricity, too, at the same time?" he asked. "And it's not just that. The whole place reeks of latent power and high science, but they use an absolute minimum of it."

"I've got a partial solution to the garrison state of affairs and the military set-up, anyhow," said Phil from the bed. "They've had a war since we've been gone."

"That's no surprise," commented Fran. Chubby, blonde Fran and dark, stocky Phil had been companions for a year aboard the Discovery. They had volunteered jointly for the exploration mission. "They should have had several of them in 250 years."

"This was an interplanetary war," retorted Phil mildly. "Or rather, it wasn't war, but occupation of the Earth by the enemy. The Jovians were smart enough not to attack Earth directly, but threw their strength at the crucial moment behind the weaker side in the war between Eurasia and the American Alliance. Then they moved in to take over the war-weakened victors."

"The classic role of the strong neutral," commented John drily. "What were the Jovians like?"

"Evidently everybody on Earth knew from first-hand experience when this book was written a century ago. There are no descriptions and no illustrations. There are some hints, though: methane-breathing, cold-loving. They had domed, refrigerated cities."

"What are you reading--a history book?" asked Ann curiously.

"Yes, it's the newest book of the whole lot, and the only one that isn't brittle and dog-eared. At that, it's the worst-made book of them all. It looks like it was printed on a hand-press and bound by hand."

"Pioneers, oh pioneers!" trilled Fran softly. "But what are they doing in the midst of all this technology?"

* * * * *

Supper in the officers' mess was a glittering affair in the military tradition. Their conversation developed some new revelations. Third Sarge Elfor was commander of the whole area that surrounded Pebbro for hundreds of miles, including the abandoned spaceport. The Topkick was ruler of the nation, and the nation was the top echelon in a co-operating hierarchy of countries of the world. For some reason, the simplified terms for enlisted men's grades had replaced higher ranks in Earth's military systems: such titles as "sarge" and "topkick." Inquiry developed that none of the officers was familiar with such designations as "captain" and "commander."

"But why is the spaceport deserted?" asked Phil. "Is space travel at such a low ebb on Earth now?"

"You are mistaken in thinking the port deserted," replied Elfor. "The big guns in the pillboxes are zeroed on your ship. If it tries to blast off, it will be destroyed."

There was no enmity in his tone, no threat. It was a simple statement of fact. He didn't elaborate, and the four from the starship discreetly asked no more about it.

After the meal, they retired with Elfor and several members of his staff to a quiet lounge. Like every other place they had seen in the building, it was lit with candelabra. They relaxed in comfortable, leather-covered chairs and the men enjoyed the long-forgotten luxury of good cigars. White-aproned servitors brought them wine in fragile, long-stemmed glasses.

"You asked about space travel from Earth," said Elfor. "Yes, you might call it at a low ebb. Yours is the first ship to blast down in fifty years, except the scout ships in the Jupiter sector.

"It is such an unusual occurrence that the Topkick is being informed daily of developments. When the men of your starship have been assured of our peaceful intentions, it will be hangared underground and the personnel quartered here until further orders from the Topkick. Meanwhile, you are the deevs of the hour and we shall drink to your return to Earth."

He stood and raised his glass. They all arose. The glasses clinked together.

"Conserve!" shouted the Third Sarge and gulped his wine.

It was a warm moment. For the first time, John felt the genuine glow, the thrill of homecoming, as he and Phil drained their glasses and performed the ancient rite of the spacemen when he sets foot on Earth once more. As in one motion, they hurled the empty glasses through the open door, to smash to pieces against the farther wall of the adjoining corridor. There was a second crashing tinkle on the heels of the first as the glasses of the women followed them closely.

It was only when he turned back to Elfor, his face alight, that John realized something was wrong. The Third Sarge stood with his mouth open in astonishment. There was something of horror on the faces of the other Earthmen. Dead silence hung in the room.

"Sleep in peace," said Elfor at last, in a strained voice. He turned on his heel and left the room. The staff members followed, coldly.

"Well, what do you make of that?" asked John, turning to the others with outspread hands. "Do you suppose those glasses were valuable heirlooms or something?"

"They looked like ordinary wine-glasses to me," said Fran. "I don't get it, but it looks like we slipped up somewhere."

The orderly who escorted them to their room cast an occasional side-long glance, full of awe, at them. Their heat-guns had been taken from their room.

"I don't know what we're in for, Tom," John said gravely into his pocket transmitter when he had tuned in to the ship. "This place is the biggest mess of contradictions I ever ran into. You'd think from the way they live that it's a decadent society living on the ruins of a former civilization.

"The perplexing thing is that they obviously have power and know how to use it, but don't."

"Your job is to find the motivation, John," replied the commander.

"Remember, we couldn't understand the underground living habits of the Deneb IV natives until we lost half a search party in one of their semi-annual meteor showers. Do you have any recommendations for the ship?"

"I'd advise you blasting off and taking an orbit," answered John, "but every gun at the spaceport is trained on the ship. I wouldn't take any chances that they don't have atomic weapons. Despite these swords and spears, we've seen several regulation heat-guns around here."

"It might interest you to know that they're keeping us awake aboard with a battery of spotlights on us all night," said Tom drily.

"Spotlights." John swore softly. "And all we have to see by are candles!"

They didn't sleep well that night. They had the distinct impression that armed guards clanked by occasionally outside in the corridor.

* * * * *

There was no indication that they were prisoners the next day, however. Third Sarge Elfor and the other officers were cordial at breakfast and lunch, although they caught some quizzical glances directed at them from time to time. Their movements were not hampered. They were given the run of the town.

After noon their armored car was brought in, hauled by four teams of horses. Flanked by a troop of soldiers, it was pulled around a corner and vanished from their sight.

"If they're so curious about how it runs, why aren't they quizzing us instead of letting us go on a sight-seeing tour?" wondered Ann, staring after the disappearing vehicle.

"I've built up a theory on these Earthmen...." began Phil. But he was interrupted as an officer and a squad of soldiers approached them. The officer saluted smartly.

"Deev John Gray, Third Sarge Elfor sends greetings and desires that you confer with him. The others will be free to continue their inspection of the military city of Pebbro."

"Very well," agreed John. "Ann, you'd better come along with me to take notes on the conference. We'll see you two tonight, if not sooner."

He motioned to the officer to lead the way, and the group went up the street, leaving Phil and Fran standing in the shadow of a towering building.

"What's your theory, Phil?" asked Fran.

"Simple," he answered. "The Jovian war wiped out civilization. They've just climbed back up part of the way, but they still don't know how to operate the machinery and use the power they have available."

"I don't know about that," said Fran doubtfully. "They seem to know how to handle those cannon and searchlights at the spaceport all right."

"Automatic control, probably, or--" Phil paused. He was peering through a barred window at street level. "Say, Fran, look here! Unless I miss my guess, this is a central power station!"

Fran stooped to look.

"I think you're right," she said. "But it's deserted."

"Proof of my theory," he said triumphantly. "Now, if we can just find a door somewhere...."

* * * * *

John and Ann had been back from a very routine conference with Elfor for more than an hour, and were enjoying the informality of the officers' cocktail lounge in their building. They were aroused by a commotion in the street outside and, along with several off-duty officers in the lounge, ran to the window to see what was up.

Phil and Fran, seated in a military jeep, were surrounded by excited soldiers. Some sort of argument was in progress, and John and Ann heard the word "credentials" mentioned.

Just as several of the soldiers, with drawn swords, dragged the couple from the jeep, one of the officers from the lounge hurried to the scene. The soldiers stood aside and saluted. There was a heated discussion, with much gesticulating, then Phil and Fran were released and headed for the lounge.

The officer got into the jeep and shifted gears. All the soldiers whipped out their swords and stood rigid, presenting arms, as he drove it to the curb at the opposite side of the street. Then he turned off the engine and got out. A guard was posted around it, and a little later a team of horses arrived to pull it away.

"How did you people get into such a predicament?" asked John when the show was over and the four of them were enjoying drinks.

"Oh, I don't think it was as serious as it looked," said Phil lightly. "We ran across a whole garage full of jeeps. We drove that one all over town before this gang stopped us and wanted to see our written authority for driving it. Everybody else saluted us. That's the military mind for you."

"Didn't it occur to you that their objections might be something other than mere military regulations?" asked John in some asperity.

"Phil has a theory--" began Fran, but Phil silenced her with a shake of the head.

"My theory can wait until I have proof for it, and I expect that in short order," said Phil, winking at Fran. "We've made good use of our time while you and Ann were in conference."

Phil and Fran were eager to know what John and Ann had learned from their conference with Elfor.

"Not much," he confessed. "Elfor is pretty close-mouthed. He's more anxious to learn about us than to give us information about their set-up.

"We did find out, though, that they've located the records of the Discovery's departure in the archives of Kansity. There seems to be

something irregular about it, but I couldn't get Elfor to go into detail."

The first hint John and Ann had of Phil's method of proving his theory was when he quietly stripped and went into the bathroom as they were preparing for supper that evening. Ann was about to remind him he had forgotten to get the orderly to bring his bath water, when they heard the sound of a shower roaring. All three crowded to the door, to find Phil luxuriating under a steaming downpour.

"What goes on here?" demanded John. "Phil, how did you know they'd started the water pumps?"

Phil smiled triumphantly.

"Try the lights," he suggested.

The others trooped back into the bedroom and Ann flicked the switches. White light blazed in the room, overpowering the feeble gleam of the candles.

"What is this, Fran?" asked John. "You were with Phil."

"We found proof of Phil's theory that these people just don't know how to operate their own machinery," replied Fran happily. "We found their main pumping station. It was in good shape, and it didn't take us long to get the engines started and the main switches thrown."

The electric lights suddenly faded and died, leaving them in candle-light again. At the same time, the sound of the shower gurgled to a stop in the bathroom. Phil appeared at the door with a towel, dripping.

"Don't tell me their machinery's given out so soon," he growled.

"Phil, this is no time to talk about discipline," snapped John angrily, "but you and Fran probably have pulled something a lot worse than the jeep this time. Neither of you is qualified in social psychology, but even so you should have been able to read the signs that they do know how to operate their machines. For some reason, they just don't operate them."

In less than five minutes, Third Sarge Elfor appeared at their door with a squad of armed men. All of these soldiers carried heat-guns.

"Two of you were observed in the vicinity of the power station today," said Elfor. "You are warned that you are suspected of having activated the power supply of the military city of Pebbro."

"We don't deny that," admitted John carefully. "We are ignorant of your customs, and hope no harm has been done."

"Your claim to ignorance will be determined at a formal hearing," retorted Elfor sternly. "We have given you the benefit of every doubt and treated you as honored deevs. I regret that this makes it necessary that all of you be placed under arrest. Your meal will be served to you in your quarters."

As soon as Elfor had gone, leaving armed guards outside their door, John tuned in the starship on his pocket transmitter.

"I would have advised against Phil's action, in view of our lack of understanding of the situation," he reported to Commander Wallace. "But I confess I wouldn't have anticipated that the result would be so extreme."

"I can't fathom their reactions, Tom. In a crazy sort of way, I suppose they fit in with all the other contradictions of their social set-up. Have you had any luck with the ship's calculator?"

"Not enough data," answered Tom. "Maybe this new stuff will help, and you might scrape for everything else you can transmit. I'd hate to try a rescue operation, because that might force us to head back for Deneb III. But if they don't decide to blast the ship in the next hour or so, there's a chance we can pull out of this trap at our end."

John did not ask for details, for he knew their conversation probably was monitored.

* * * * *

The four of them sat up half the night poring over the books in their room. They gleaned nothing except from the "history" Phil had been reading the night before. Unfortunately, it was not a general history, but the flowery story of a high military family. The sort of references they found were, "after the Jovian invaders had been driven from Earth" and "Second Sarge Vesix participated in the bombardment that destroyed the Jovian tyrants." No details.

What did emerge from their study was a picture of the rise of a military aristocracy on the ashes of an earlier civilization which had been ground to pieces under the heels of alien rulers.

There was good news from the starship at dawn.

"We're orbiting," said Commander Wallace with quiet pride. "Shortly after I talked with you last night, they called on us to surrender or be blasted. I asked time for a conference of officers and promised to fire a rocket from the nose if we decided to surrender.

"I fired the rocket all right, but it was an instantaneous smoke screen rocket. I still don't know whether their guns are manned or robot-controlled, but I gambled that their firing was keyed to the sight of the ship blasting off instead of to vibration. We were half a mile up before they could swing into action, and we didn't get a scratch."

A rescue mission with one of the scout rockets was too risky against the strong forces of the Earthmen. Tom mentioned that fast planes had followed them into the stratosphere. But one thing was done for the imprisoned four.

Soon after breakfast, they were taken under guard to a Spartan courtroom, presided over by Third Sarge Elfor.

"We have received a warning from your colleagues," Elfor said grimly. "They broadcast to us a short time ago that if harm came to you, this city and others will be destroyed before they leave the solar system. In case you knew of this and it has in any way raised your hopes, I wish to remind you that Earth's cities have been destroyed before. This threat will not affect our decision to mete strict justice to you.

"You are charged with being enemies of the people of Earth, and with having landed on Earth under false colors with the intent of sabotage and espionage. Your prosecutor will be Fifth Tech Jatoo, representing the nations of Earth. You will be permitted to speak in your own defense."

Jatoo was a slender, thin-faced man with the air of an experienced attorney.

"The governments of Earth make these charges against the joint

defendants," he began matter-of-factly: "That they are members of a rebellious and traitorous group who are allied with the Jovians and maintain an illegal, secret base on some planet or moon of the solar system; that they came here under the guise of strangers, with the specific intent of espionage and sabotage of Earth's defense against the Jovian enemy; and that they actually began such operations.

"We shall present the following major evidence in support of these charges:

"First, that the defendants did travel from the Numex spaceport to the military town of Pebbro in a vehicle, the motive power of which is still unknown but which obviously must utilize fuel, in violation of the conservation laws;

"Second, that the defendants' colleagues did not approach the peoples of Earth in peace, but remained enfortressed in an armed space vessel;

"Third, that the defendants Phil Alcorn and Fran Golden did throw the switches activating the electrical system and powered water system of the military town of Pebbro, that the above-named two defendants did utilize a military power vehicle for pleasure purposes and that all the defendants did unnecessarily destroy glass drinking vessels, all in violation of the conservation laws;

"And, fourth, that the starship Discovery, listed in ancient records as having departed on a colonizing mission to the third planet of the star Deneb, was not scheduled to return to Earth for another seventy-five years and therefore could not be the ship in which the defendants arrived, as claimed."

Elfor inclined his head toward the quartet from the starship, who sat behind a long table on the side of the room opposite Jatoo.

"You may state what your defense will be," he said.

"Our defense to the first three items of evidence," answered John, who had been taking notes, "is that we have been absent from Earth for more than 250 Earth-years and that we were, and are, ignorant of your laws and customs. Thus, we are innocent of intent to violate them. Our defense to the fourth item of evidence is that certain improvements were made in the engines of the starship Discovery while colonization of Deneb III was in progress, making it possible for us to return to Earth ahead of schedule. Our defense to all three charges made against

us is that they are false."

It was a monotonous trial, with a parade of witnesses brought to the stand by Jatoo, all of whom testified to seeing the defendants perform one or more acts of "unconservation."

"In the courts of Earth, a case can be decided only on the evidence presented," said Third Sarge Elfor when John had offered his brief defense for the quartet. "The defendants have presented no evidence, only argument. The fact that the defendants' clothing corresponds to that in use two and a half centuries ago cannot be considered competent, as it could be copied easily.

"For the safety of Earth, the defendants are found guilty and remanded for immediate execution. In view of the existence of doubt as to their treasonable intent and their previous status as deevs, they are accorded the honor of death by power weapons. Conserve!"

* * * * *

Shocked and silent, the four were led to a courtyard outside. As they walked, John switched on his pocket transmitter with a casual, almost unnoticeable gesture, and murmured a report to the ship.

"I'm sorry, John," said the commander, his voice tense with emotion. "There's no possibility of rescue, and I know it's small satisfaction to you that your deaths will be avenged."

The quartet's hands were bound behind them and they were lined up against a wall. The Third Sarge, attended by a good-sized retinue, stood at ease nearby, smoking a cigar, to direct the execution personally.

"'Power weapons' to them apparently mean regulation heat-guns," remarked Phil, almost jocularly. "That's what the fellow has."

A soldier was standing square in the center of the courtyard, a pistol dangling from his grip. At a signal from Elfor, he lifted it.

"Looks like I'm first," said John, bracing himself. "Be seeing you, somewhere."

He gritted his teeth for the wave of unbearable heat that was sure to come. Instead, there was a silent explosion in the midst of the

courtyard and the soldier who had held the gun writhed on the ground, incinerated.

"John! The gun exploded!" cried Phil in amazement. "I've only seen that happen once before!--Remember that crewman who wouldn't take the trouble to keep his gun clean?"

John was thinking fast.

"I remember," he said in a low voice. His heart was still racing from the reaction of his near brush with death. "There's a pattern here. If I could only get a chance to talk over things sensibly with this Third Sarge...."

There was great excitement among the soldiery. Several of the men were crowded around the corpse of the marksman. Elfor stood nervously, his hand on his own holstered gun.

"They're concealing weapons," he barked to his aides. "Search them!"

A squad of guards swarmed over the four prisoners. There was an excited twitter when they discovered the pocket transmitters. They removed the little packets, snapping the aerial wires, and carried them to Elfor. He glanced at them, took one in his hand, and ordered:

"Execute them!"

Another guard with a heat-gun took his position in the center of the courtyard. He handled the weapon somewhat gingerly, but checked its mechanism and prepared to follow orders.

He waited for the command from Elfor. But the Third Sarge now was staring hard at the little transmitter in his hand. Instead of ordering the guard to fire, he strode across the courtyard and thrust the tiny radio before John's face.

"Is this true?" he demanded. He pointed at the well-known symbol stamped on the packet, the red diagram of an atom that warned against opening the lead-shielded mechanism without precaution.

"You mean, is it atomic-powered?" asked John. "Yes it is."

"It is a weapon?"

"No, it's a radio transmitter."

"But it operates?"

"Certainly it operates. Why in thunder do you think I'd be carrying a useless transmitter?"

"It has been many years since this sign was seen on a working mechanism on Earth," said Elfor soberly. "You are familiar, then, with atomic power?"

"I'm not an atomic technician," answered John carefully, "but there are several on the Discovery who can build anything from one of these little transmitters to the engines of a spaceship, with the proper equipment."

The Third Sarge stood in silent thought for several minutes. He was high in the councils of his country, or he would not have been commander of the zone that guarded Numex spaceport. He knew the reason for the basic slogan "Conserve!" and he knew, as 99 per cent of his subordinates did not, what circumstances would make that slogan meaningless.

"Guard!" he growled. "Unbind the deevs! John Gray, come with me in peace."

"You'd better give me back that transmitter, first," suggested John drily. "I'd hate to escape execution just to get H-bombed by my own ship."

* * * * *

It was the next afternoon that the four were escorted by a trim-uniformed guard of honor across the flat spaceport to the Discovery.

"The Jovians wanted to reduce Earth to colonial status, to be exploited for its natural resources," John explained to his companions as they walked. "All atomic installations were destroyed, all technicians and scientists exterminated systematically and all scientific books burned. They were very thorough about it.

"The successful revolt was accomplished with a concealed stock-pile of atomic weapons. Since that time, they've been garrisoned against

the return of the Jovians. But atomic power was gone and so were the scientists who could bring it back and the books from which new scientists could learn.

"It's because they can't replace even so small a thing as an electric light bulb that destruction or unnecessary use of any sort of equipment is the rankest sort of treason. They've been saving all their technological capital for a last-ditch stand against the expected invasion.

"And it was their faulty, groping sort of maintenance that saved our lives, because even a heat-gun deteriorates in 150 years. That gun hadn't been fired since the Revolt!"

"Then we can be their salvation?" suggested Phil.

"Yes. The scientists who built the Deneb colony can rebuild the technology of our own Earth. It will take a long time ... there'll have to be schools and we'll all have to work hard ... but maybe some of us will be able to go back, in 30 or 40 years, say, when the Discovery can return to Deneb."

They were nearing the ship, and John saw the officers crowding the main port, watching them come.

"It's sort of inconsequential, I know," said Ann then. "But several times the Third Sarge referred to us as 'deevs.' Did he mention to you what a deev is?"

John smiled.

"It's an ancient military slang term, just like 'sarge' and 'topkick,'" he replied. "'Deev' is just plain old D.V. Distinguished Visitor. And I suppose we are, at that."

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LECTURE IV., THE FORCE OF GRAVITY.

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of *Experimental Mechanics*, by Robert Stawell Ball

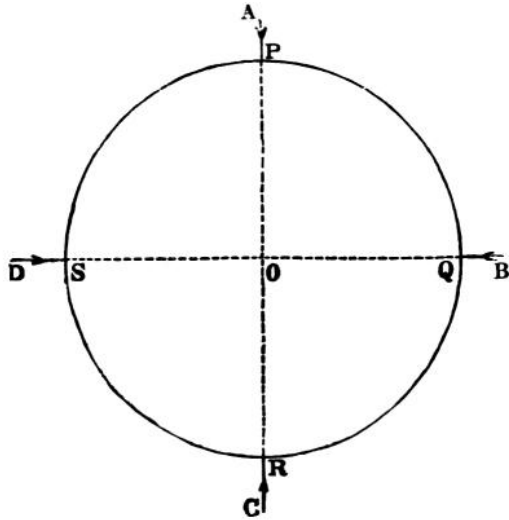
1888

Introduction.—Specific Gravity.—The Plummet and Spirit-Level.—The Centre of Gravity.—Stable and Unstable Equilibrium.—Property of the Centre of Gravity in a Revolving Wheel.

INTRODUCTION.

81. In the last three lectures we considered forces in the abstract; we saw how they are to be represented by straight lines, how compounded together and how decomposed into others; we have explained what is meant by forces being in equilibrium, and we have shown instances where the forces lie in the same plane or in different planes, and where they intersect or are parallel to each other. These subjects are the elements of mechanics; they form the framework which in this and subsequent lectures we shall try to present in a more attractive garb. We shall commence by studying the most remarkable force in nature, a force constantly in action, and one to which all bodies are subject, a force which distance cannot annihilate, and one the properties of which have led to the most sublime discoveries of human intellect. This is the force of gravity.

82. If I drop a stone from my hand, it falls to the ground. That which produces motion is a force: hence the stone must have been acted upon by a force which drew it to the ground. On every part of the earth's surface experience shows that a body tends to fall. This fact proves that there is an attractive force in the earth tending to draw all bodies towards it.



[Illustration: FIG. 25.]

83. Let A B C D (Fig. 25) be points from which stones are let fall, and let the circle represent the section of the earth; let P Q R S be the points at the surface of the earth upon which the stones will drop when allowed to do so. The four stones will move in the directions of the arrows: from A to P the stone moves in an opposite direction to the motion from C to R; from B to Q it moves from right to left, while from D to S it moves from left to right. The movements are in different directions; but if I produce these directions, as indicated by the dotted lines, they each pass through the centre O.

84. Hence each stone in falling moves towards the centre of the earth, and this is consequently the direction of the force. We therefore assert that the earth has an attraction for the stone, in consequence of which it tries to get as near the earth's centre as possible, and this attraction is called the force of gravitation.

85. We are so excessively familiar with the phenomenon of seeing bodies fall that it does not excite our astonishment or arouse our curiosity. A clap of thunder, which every one notices, because much less frequent, is not really more remarkable. We often look with attention at the attraction of a piece of iron by a magnet, and justly so, for the phenomenon is very interesting, and yet the falling of a stone is produced by a far grander and more important force than the force of magnetism.

86. It is gravity which causes the weight of bodies. I hold a piece of lead in my hand: gravity tends to pull it downwards, thus producing a

pressure on my hand which I call _weight_. Gravity acts with slightly varying intensity at various parts of the earth's surface. This is due to two distinct causes, one of which may be mentioned here, while the other will be subsequently referred to. The earth is not perfectly spherical; it is flattened a little at the poles; consequently a body at the pole is nearer the general mass of the earth than a body at the equator; therefore the body at the pole is more attracted, and seems heavier. A mass which weighs 200 lbs. at the equator would weigh one pound more at the pole: about one-third of this increase is due to the cause here pointed out. (See Lecture XVII.)

87. Gravity is a force which attracts every particle of matter; it acts not merely on those parts of a body which lie on the surface, but it equally affects those in the interior. This is proved by observing that a body has the same weight, however its shape be altered: for example, suppose I take a ball of putty which weighs 1 lb., I shall find that its weight remains unchanged when the ball is flattened into a thin plate, though in the latter case the surface, and therefore the number of superficial particles, is larger than it was in the former.

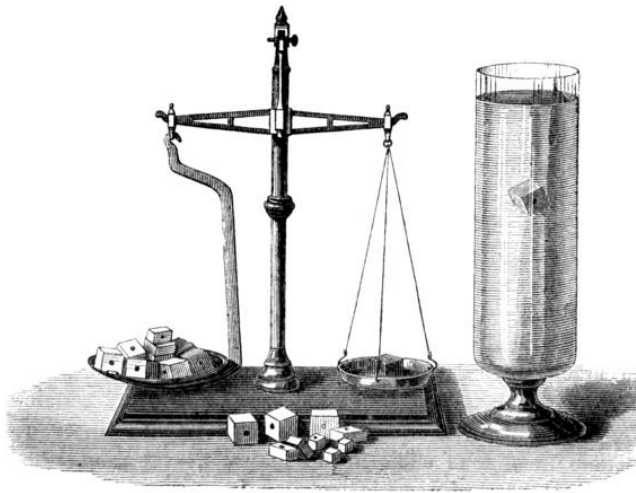
SPECIFIC GRAVITY.

88. Gravity produces different effects upon different substances. This is commonly expressed by saying that some substances are heavier than others; for example, I have here a piece of wood and a piece of lead of equal bulk. The lead is drawn to the earth with a greater force than the wood. Substances are usually termed heavy when they sink in water, and light when they float upon it. But a body sinks in water if it weighs more than an equal bulk of water, and floats if it weigh less. Hence it is natural to take water as a standard with which the weights of other substances may be compared.

89. I take a certain volume, say a cubic inch of cast iron such as this I hold in my hand, and which has been accurately shaped for the purpose. This cube is heavier than one cubic inch of water, but I shall find that a certain quantity of water is equal to it in weight; that is to say, a certain number of cubic inches of water, and it may be fractional parts of a cubic inch, are precisely of the same weight. This number is called the _specific gravity of cast iron_.

90. It would be impossible to counterpoise water with the iron without holding the water in a vessel, and the weight of the vessel must then be allowed for. I adopt the following plan. I have here a number of

inch cubes of wood (Fig. 26), which would each be lighter than a cubic inch of water, but I have weighted the wooden cubes by placing grains of shot into holes bored into the wood. The weight of each cube has thus been accurately adjusted to be equal to that of a cubic inch of water. This may be tested by actual weighing. I weigh one of the cubes and find it to be 252 grains, which is well known to be the weight of a cubic inch of water.



[Illustration: FIG. 26.]

91. But the cubes may be shown to be identical in weight with the same bulk of water by a simpler method. One of them placed in water should have no tendency to sink, since it is not heavier than water, nor on the other hand, since it is not lighter, should it have any tendency to float. It should then remain in the water in whatever position it may be placed. It is difficult to prepare one of these cubes so accurately that this result should be attained, and it is impossible to ensure its continuance for any time owing to changes of temperature and the absorption of water by the wood. We can, however, by a slight modification, prove that one of these cubes is at all events nearly equal in weight to the same bulk of water. In Fig. 26 is shown a tall glass jar filled with a fluid in appearance like plain water, but it is really composed in the following manner. I first poured into the jar a very weak solution of salt and water, which partially filled it; I then poured gently upon this a little pure water, and finally filled up the jar with water containing a little spirits of wine: the salt and water is a little heavier than pure water, while the spirit and water is a little lighter. I take one of the cubes and drop it gently into the glass; it falls through the spirit and water, and after making a few oscillations settles itself at rest in the stratum shown in the figure.

This shows that our prepared cube is a little heavier than spirit and water, and a little lighter than salt and water, and hence we infer that it must at all events be very near the weight of pure water which lies between the two. We have also a number of half cubes, quarter cubes, and half-quarter cubes, which have been similarly prepared to be of equal weight with an equal bulk of water.

92. We shall now be able to measure the specific gravity of a substance. In one pan of the scales I place the inch cube of cast iron, and I find that $7\frac{1}{4}$ of the wooden cubes, which we may call cubes of water, will balance it. We therefore say that the specific gravity of iron is $7\frac{1}{4}$. The exact number found by more accurate methods is 7·2. It is often convenient to remember that 23 cubic inches of cast iron weigh 6 lbs., and that therefore one cubic inch weighs very nearly $\frac{1}{4}$ lb.

93. I have also cubes of brass, lead, and ivory; by counterpoising them with the cubes of water, we can easily find their specific gravities; they are shown together with that of cast iron in the following table:—

Substance.	Specific Gravity.
Cast Iron	7·2
Brass	8·1
Lead	11·3
Ivory	1·8

94. The mode here adopted of finding specific gravities is entirely different from the far more accurate methods which are commonly used, but the explanation of the latter involve more difficult principles than those we have been considering. Our method rather offers an explanation of the nature of specific gravity than a good means of determining it, though, as we have seen, it gives a result sufficiently near the truth for many purposes.

THE PLUMMET AND SPIRIT-LEVEL.

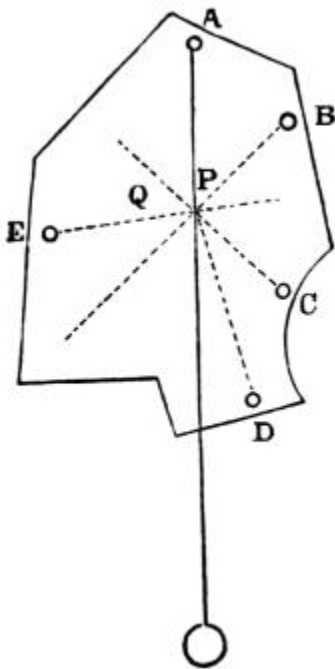
95. The tendency of the earth to draw all bodies towards it is well illustrated by the useful “line and plummet.” This consists merely of a string to one end of which a leaden weight is attached. The string when at rest hangs vertically; if the weight be drawn to one side, it will, when released, swing backwards and forwards, until it finally settles again in the vertical; the reason is that the weight always tries to get as near the earth as it can, and this is accomplished when the string hangs vertically downwards.

96. The surface of water in equilibrium is a horizontal plane; that is also a consequence of gravity. All the particles of water try to get as near the earth as possible, and therefore if any portion of the water were higher than the rest, it would immediately spread, as by doing so it could get lower.

97. Hence the surface of a fluid at rest enables us to find a perfectly horizontal plane, while the plummet gives us a perfectly vertical line: both these consequences of gravity are of the utmost practical importance.

98. The spirit-level is another common and very useful instrument which depends on gravity. It consists of a glass tube slightly curved, with its convex surface upwards, and attached to a stand with a flat base. This tube is nearly filled with spirit, but a bubble of air is allowed to remain. The tube is permanently adjusted so that, when the plate is laid on a perfectly horizontal surface, the bubble will stand in the middle: accordingly the position of the bubble gives a means of ascertaining whether a surface is level.

THE CENTRE OF GRAVITY.



[Illustration: FIG. 27.]

99. We proceed to an experiment which will give an insight into a curious property of gravity. I have here a plate of sheet iron; it has the irregular shape shown in Fig. 27. Five small holes A B C D E are punched at different positions on the margin. Attached to the framework is a small pin from which I can suspend the iron plate by one of its holes A: the plate is not supported in any other way; it hangs freely from the pin, around which it can be easily turned. I find that there is one position, and one only, in which the plate will rest; if I withdraw it from that position it returns there after a few oscillations. In order to mark this position, I suspend a line and plummet from the pin, having rubbed the line with chalk. I allow the line to come to rest in front of the plate. I then flip the string against the plate, and thus produce a chalked mark: this of course traces out a vertical line A P on the plate.

I now remove the plummet and suspend the plate from another of its holes B, and repeat the process, thus drawing a second chalked line B P across the plate, and so on with the other holes: I thus obtain five lines across the plate, represented by dotted lines in the figure. It is a very remarkable circumstance that these five lines all intersect in the same point P; and if additional holes were bored in the plate, whether in the margin or not, and the chalk line drawn from each of them in the manner described, they would one and all pass through the same point. This remarkable point is called the centre of gravity of the plate, and the result at which we have arrived may be expressed by saying that the vertical line from the point of suspension always passes through the centre of gravity.

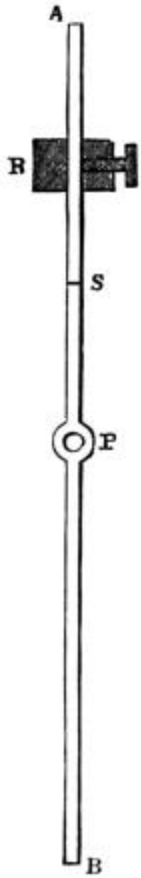
100. At the centre of gravity P a hole has been bored, and when I place the supporting pin through this hole you see that the plate will rest indifferently in all positions: this is a curious property of the centre of gravity. The centre of gravity may in this respect be contrasted with another hole Q, which is only an inch distant: when I support the plate by this hole, it has only one position of rest, viz. when the centre of gravity P is vertically beneath Q. Thus the centre of gravity differs remarkably from any other point in the plate.

101. We may conceive the force of gravity on the plate to act as a force applied at P. It will then be easily seen why this point remains vertically underneath the point of suspension when the body is at rest. If I attached a string to the plate and pulled it, the plate would evidently place itself so that the direction of the string would pass through the point of suspension; in like manner gravity so places

the plate that the direction of its force passes through the point of suspension.

102. Whatever be the form of the plate it always contains one point possessing these remarkable properties, and we may state in general that in every body, no matter what be its shape, there is a point called the centre of gravity, such that if the body be suspended from this point it will remain in equilibrium indifferently in any position, and that if the body be suspended from any other point, then it will be in equilibrium when the centre of gravity is directly underneath the point of suspension. In general, it will be impossible to support a body exactly at its centre of gravity, as this point is within the mass of the body, and it may also sometimes happen that the centre of gravity does not lie in the substance of the body at all, as for example in a ring, in which case the centre of gravity is at the centre of the ring. We need not, however, dwell on these exceptional cases, as sufficient illustrations of the truth of the laws mentioned will present themselves subsequently.

STABLE AND UNSTABLE EQUILIBRIUM.



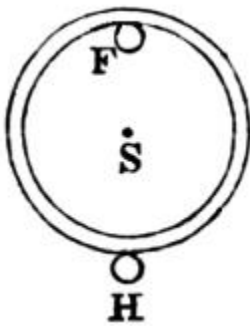
[Illustration: FIG. 28.]

103. An iron rod A B, capable of revolving round an axis passing through its centre P, is shown in Fig. 28.

The centre of gravity lies at the centre B, and consequently, as is easily seen, the rod will remain at rest in whatever position it be placed. But let a weight R be attached to the rod by means of a binding screw. The centre of gravity of the whole is no longer at the centre of the rod; it has moved to a point S nearer the weight; we may easily ascertain its position by removing the rod from its axle and then ascertaining the point about which it will balance. This may be done by placing the bar on a knife-edge, and moving it to and fro until the right position be secured; mark this position on the rod, and return it to its axle, the weight being still attached. We do not now find that the rod will balance in every position. You see it will balance if the point S be directly underneath the axis, but not if it lie to one side or the other. But if S be directly over the axis, as in the figure, the rod is in a curious condition. It will, when carefully placed, remain at rest; but if it receive the slightest displacement, it will tumble

over. The rod is in equilibrium in this position, but it is what is called unstable equilibrium. If the centre of gravity be vertically below the point of suspension, the rod will return again if moved away: this position is therefore called one of stable equilibrium. It is very important to notice the distinction between these two kinds of equilibrium.

104. Another way of stating the case is as follows. A body is in stable equilibrium when its centre of gravity is at the lowest point: unstable when it is at the highest. This may be very simply illustrated by an ellipse, which I hold in my hand. The centre of gravity of this figure is at its centre. The ellipse, when resting on its side, is in a position of stable equilibrium and its centre of gravity is then clearly at its lowest point. But I can also balance the ellipse on its narrow end, though if I do so the smallest touch suffices to overturn it. The ellipse is then in unstable equilibrium; in this case, obviously, the centre of gravity is at the highest point.



[Illustration: FIG. 29.]

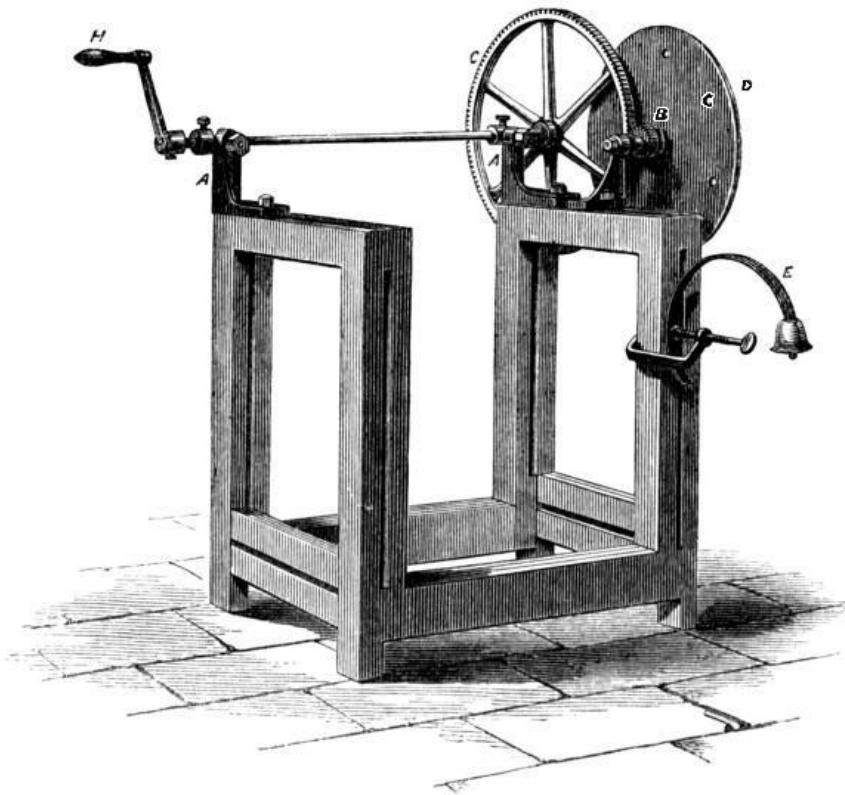
105. I have here a sphere, the centre of gravity of which is at its centre; in whatever way the sphere is placed on a plane, its centre is at the same height, and therefore cannot be said to have any highest or lowest point; in such a case as this the equilibrium is neutral. If the body be displaced, it will not return to its old position, as it would have done had that been a position of stable equilibrium, nor will it deviate further therefrom as if the equilibrium had been unstable: it will simply remain in the new position to which it is brought.

106. I try to balance an iron ring upon the end of a stick H, Fig. 29, but I cannot easily succeed in doing so. This is because its centre of gravity S is above the point of support; but if I place the stick at F, the ring is in stable equilibrium, for now the centre of gravity is

below the point of support.

PROPERTY OF THE CENTRE OF GRAVITY IN A REVOLVING WHEEL.

107. There are other curious consequences which follow from the properties of the centre of gravity, and we shall conclude by illustrating one of the most remarkable, which is at the same time of the utmost importance in machinery.



[Illustration: FIG. 30.]

108. It is generally necessary that a machine should work as steadily as possible, and that undue vibration and shaking of the framework should be avoided: this is particularly the case when any parts of the machine rotate with great velocity, as, if these be heavy, inconvenient vibration will be produced when the proper adjustments are not made. The connection between this and the centre of gravity will be understood by reference to the apparatus represented in the accompanying figure (Fig. 30). We have here an arrangement consisting of a large cog wheel C working into a small one B, whereby, when the handle H is turned, a velocity of rotation can be given to the iron

disk D, which weighs 14 lbs, and is 18" in diameter. This disk being uniform, and being attached to the axis at its centre, it follows that its centre of gravity is also the centre of rotation. The wheels are attached to a stand, which, though massive, is still unconnected with the floor. By turning the handle I can rotate the disk very rapidly, even as much as twelve times in a second. Still the stand remains quite steady, and even the shutter bell attached to it at E is silent.

109. Through one of the holes in the disk D I fasten a small iron bolt and a few washers, altogether weighing about 1 lb.; that is, only one-fourteenth of the weight of the disk. When I turn the handle slowly, the machine works as smoothly as before; but as I increase the speed up to one revolution every two seconds, the bell begins to ring violently, and when I increase it still more, the stand quite shakes about on the floor. What is the reason of this? By adding the bolt, I slightly altered the position of the centre of gravity of the disk, but I made no change of the axis about which the disk rotated, and consequently the disk was not on this occasion turning round its centre of gravity: this it was which caused the vibration. It is absolutely necessary that the centre of gravity of any heavy piece, rotating rapidly about an axis, should lie in the axis of rotation. The amount of vibration produced by a high velocity may be very considerable, even when a very small mass is the originating cause.

110. In order that the machine may work smoothly again, it is not necessary to remove the bolt from the hole. If by any means I bring back the centre of gravity to the axis, the same end will be attained. This is very simply effected by placing a second bolt of the same size at the opposite side of the disk, the two being at equal distances from the axis; on turning the handle, the machine is seen to work as smoothly as it did in the first instance.

111. The most common rotating pieces in machines are wheels of various kinds, and in these the centre of gravity is evidently identical with the centre of rotation; but if from any cause a wheel, which is to turn rapidly, has an extra weight attached to one part, this weight must be counterpoised by one or more on other portions of the wheel, in order to keep the centre of gravity of the whole in its proper place. Thus it is that the driving wheels of a locomotive are always weighted so as to counteract the effect of the crank and restore the centre of gravity to the axis of rotation. The cause of the vibration will be understood after the lecture on centrifugal force (Lect. XVII.).



4-1/2B, EROS

By Malcolm Jameson

*"4-1/2B, Eros."... A strange code, but
grizzled space-trader Karns used it to
break the perilous Mercury-Venus Jinx.*

[Transcriber's Note: This Project Gutenberg
etext, #61863, was produced from
Planet Stories Spring 1941.

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"Makee chop chop. Kwei! Kwei!"

The two Venusian coolies squatted down between the shafts and with one quick motion elevated the sedan chair to shoulder height. Then they started off in a lazy run through the torrential downpour, splashing mud right and left as their sturdy yellow legs struck into the watery lane of muck that passes for a road in Venusberg. Captain Hank Karns, the Lone Trader, sank back in his seat and watched idly with mild blue eyes as first one grass hut and then another appeared momentarily through rifts of rain. There would be time enough to worry about Cappy Wilkerson's plight when he reached the administration building and found out more about the charges against him. No doubt it was just another shakedown, the effort of some minor official to pry loose a little more than the customary cumshaw.

Captain Karns had berthed his own old trading tub not an hour earlier and as he registered the arrival of his _Swapper_ he noted that under the date of three days before there was the entry: "_Wanderer_, Captain Wilkerson, en route Mercury to Luna." After it was the notation in red: "Detained by order Collector of the Port; captain in custody."

Hank Karns thoughtfully pawed his long white beard. Cappy Wilkerson was a careful and upright man and a lifelong friend; what manner of charge could they have trumped up against him? That they were trumped up he took for granted, for the local government of autonomous Venus was notoriously corrupt and always had been. The Venusians themselves were the descendants of coolies brought centuries before from tropical Asia. They took little or no interest in government. Politics had, therefore, fallen into the hands of white adventurers, most of whom lived on Venus for the very good reason they were not wanted elsewhere. The Central Council of the loose Interplanetary Federation seldom interfered with them unless for acts so flagrant as to affect the Federation as a whole.

The old space merchant left his chair at the courtroom and squeezed through the crowd at the back just in time to hear the whack, whack, whack of the gavel marking the end of the trial. Standing defiantly

in the prisoner's box was Cappy Wilkerson, his eyes flashing and his iron-gray mane thrown back. He looked like an indignant old lion brought to bay by a pack of jackals. The judge, a young man with a monocle and a stiff black pompadour, was dressed in a smart military uniform which made him appear anything but judicial. He was biting out his words as if what he was saying was inspired by personal venom.

"I have heard all you have had to say, including your filthy imputations as to the integrity of this court. Your guilt is so apparent that we need not trouble even to preserve the record of your silly and malicious allegations...."

Here the judge contemptuously tossed a sheaf of papers into a wastebasket.

"Therefore, bearing in mind not only your guilt but your contumacious conduct before me, I sentence you to five years at hard labor in such a one of our prison camps as the Director of Welfare and Beneficence may select.

"It is further directed that your ship, together with its illicit contents, be confiscated and sold at public auction in order to defray the cost of these proceedings. Marshal! Take him away."

Hank Karns was on his feet at once, elbowing and pushing his way forward through the departing throng of curiosity-seekers. His voice was shrill with indignation.

"Hey, you can't do that!" he yelled. Officials closed in on him at once, and the judge's face grew red with anger. "This is a court of law," he said, "and the decisions of the presiding judge are final. Now get out before I haul you up for contempt."

"Tarnation damn!" muttered Hank Karns as he turned and left the building. This was no ordinary shakedown. This called for action, and quick action, for it was unthinkable that his buddy should be carted off to the insect-infested, fever-ridden, infamous Great Swamp of Venus. White men lived but a few months there; a year, let alone five years, was as good as life.

A bulletin caught his eye, and as he read it he gasped. The paste that fastened it to the board was still wet, but the paper bore characteristics of printed type. It must have been prepared at least a day ago. It read:

COLLECTOR'S SALE

*One confiscated tube ship, the _Wanderer_, complete with fittings.
The cargo of the same consisting of miscellaneous trade goods.
Saturday. Inquire at Collector's Office for details.*

"Phew!" gasped Hank Karns. "_That_ was quick work. And planned." He turned and made his way to the Collector's Office.

The man at the front desk gaped at him woodenly.

"S'already sold," he said indifferently, the third time Karns put his question.

"But it says Saturday...."

"Okay--it says Saturday. So what?"

"B-but this is only Tuesday...."

"We have a Saturday every week, dodo. Now trot along and annoy somebody else for a change. I have work to do."

Hank Karns blinked. Why, Saturday was the day the _Wanderer_ docked. These Venusians were getting raw. They must have sold her that very day!

"Who is that old man? Throw him out!"

Karns turned slowly and viewed the new speaker. He was a big man, with piercing black eyes and a hawk nose, and heavily bearded--a strange sight for super-tropical Venus where men kept clean shaven for coolness. But the man turned abruptly away and entered an inner office, slamming the door behind him. Hank Karns' eyes followed him all the way--they were fixed on the back of the fellow's neck. There, oddly enough, just above the shoulder line, peeped a line of color demarcation. Above the line, which was made visible by the fact that its wearer had pulled open his collar for comfort, the skin was the normal pallor usually seen on Venus; below, it was a mottled chocolate color.

"Didja hear what the collector said?" snarled the clerk. "Scram!"

Without a word, Hank Karns turned and left the office. He passed

through the thronged corridors almost in a daze. There was Cappy Wilkerson, gone to the Swamp, virtually condemned to death. There was his ship sold, even before the trial which was to condemn it. And everywhere there was high-handed insolence, seemingly inspired by this overbearing man with the duplex complexion. What did it mean? And the fact that he could not yet place those sharp eyes and that predatory nose, though somewhere, sometime, he had encountered them before, puzzled Hank Karns still more. Something stank in Venus.

* * * * *

An hour later he sat morosely in a tiny tavern he had long known, hidden up the blind alley known as Artemis Lane. For half a century it had been familiar to him as the hangout for his kind.

"So you see how it is," the bartender was concluding. "At this rate there won't be any more. With all the old-timers dead or in the Swamp, how in hell can _I_ keep running. No sir, this joint is for sale--for what it'll bring. Drink up and have another."

Captain Karns took the proffered drink from the grizzled tavern-keeper, but despite its cheering nature--for it was purest "comet-dew"--he took it glumly. Never in all his long and active life had he heard so much evil news at one sitting. Another of his old pals had come to grief, and all because he had touched at Mercury. Mercury, it appeared, was poison to all his tribe. The record was too consistent to be accounted for by coincidence. Coincidents do not occur in strings.

"And what makes it stink all the worse," persisted the indignant bartender, bitterly, "not a damn finger is lifted to stop the flow of trilibaine. The town is lousy with it. Half these natives stay hopped up all the time."

"I thought the Federals had cleaned that up ten years ago," commented Hank Karns.

"It's back," was the laconic retort.

Hank Karns said nothing. The fact that three of his buddies were languishing in the malarial swamps of Venus, continually subject to the indignities of brutal guards was uppermost in his mind. And besides that, two others--Bill Ellison and Jed Carter--had died on Mercury when their ships mysteriously blew up on the take-off. That, too, had an especial significance, for those two were the only members of the

trader tribe who had any sort of reputation as fire-eaters. In their youth, of course, all of them had been bolder and more truculent, but as they gained in experience they learned that there is more to be gained by soft words than bluster. If Hank was to secure the release of his friends it must be by guile, the use of a cunning superior to that employed by their common enemies.

If he was to secure! There was no if about it. He must. For it was Bob Merrill and Ben Wilkerson who had once rescued him, Hank Karns, from an even more deadly situation. More than twenty years ago that had been, on far-off Io, and Hank Karns winced at the memory of it. On that occasion he had, through the machinations of the notorious Von Kleber gang, been convicted and sentenced as a pirate. Ten hateful and horror-filled days and nights he had spent in the mines of Sans Espérance, the Federal Penitentiary, digging radioactive ores. Two of his friendly competitors heard of it and pled for a new trial wherein it was shown that he had been sent up through perjured testimony to screen the trial of the real culprits. The wave of public opinion they started then did not subside until Von Kleber and his outlaws were put finally behind the bars.

No, there was no choice. Cappy Wilkerson and Cappy Merrill must be released and Ellison and Carter avenged. How? That remained to be seen.

"Wa-al," drawled Hank Karns, elaborately, now that his mind was made up, "I'll be seein' you. I'm taking a little trip into Mercury and back."

The bartender shook his head ominously.

"No fool like an old fool," he said, and he didn't laugh.

In the rain-lock, or the vestibule outside the bar, Karns stopped. He felt inside the lining of his vest and after much fumbling produced a dog-eared memorandum book. He ran through the yellowed pages until he found one covered with cryptic entries. They appeared as if made long ago, but several interlineations in various colored inks showed that amendments had been made from time to time since the original writing of them.

Halfway down was the group P2, and what followed had been twice changed. The line that stood in lieu of them read:
"Vbg--wickerware--4-1/2B, Eros." Hank Karns read the line through two or three times, then snapped the book shut and replaced it in

its hiding place. He carefully buckled up his slicker and jammed his sou'wester tight upon his head. Then he stepped forth into the steamy drizzle of Artemis Lane.

He sloshed his way through mud and water until he came to the main drag. He turned to the right and splashed along until he came to the corner where Erosville Road turned off. He took the turn and plugged along for four blocks of its twisting, boggy length. A dozen steps farther on he lifted his eyes and peered from beneath dripping brows at the signs about. Across the street was what he sought--a sagging awning crudely painted with the legend; "An Shirgar--Dealer in Native Basketry." On the bedewed window below was another, "Hir Spak Anglass."

Hank Karns stopped under the awning long enough to squish some of the water out of his shoes, then he entered. A swarthy, turbanned Venusian met him, rubbing his hands together obsequiously and bowing jerkily at every step.

"Yiss, milord. Valcom to mizrabable shop. Vat vishes milord?"

"Wickerware," said Hank Karns, tartly, for him. "For export."

"Ah," breathed the representative of An Shirgar. "Zhipluds, eh? You pay?" Captain Karns shook his head, and pointed to the private door at the back.

"Ah, vickware. No pay. Maybe boss ut see, eh?"

"Yep, trot him out," said Hank Karns, and began fingering the clever basketware of the Venutian hillmen. He knew it would be quite a while before the Earth-man came, if this was operated like the Callistan branch had been, twenty years before. After a time, without quite knowing how he knew, he was aware that someone else was in the showroom, studying him from a distance.

"Howdy," he said, turning around. "I kinda wanted to finance a deal that's too big for me to swing--is this the place?"

"Might be," said the man non-committally. He was a typical Terrestrial business man, not much over thirty, baldish, and plainly not given to foolishness. "I don't touch anything as a rule unless I see a profit in it. And no chance of loss. What is your collateral?"

Hank Karns mentioned his ship. The man snorted, and started to turn

away. "You're wasting time."

"I got a ring, too. It's a--well--sorta heirloom."

The man came back. He was still not interested, but he took the ring Karns offered him and weighed it in his hand. Then he applied a loup to his eye and examined it closely.

"You've hocked this before?"

"Yes," chuckled Hank Karns. "And got it back, too."

"Hmmm," said the man. "It looks genuine. What do you want?"

"I--uh--am dropping into Mercury to do a little trading. When I get back I might want to buy a chair or so--mebbe a houseful of stuff--and just wanted to be sure my credit was good."

"You speak in riddles, my friend," said the man with a curious, tight little smile. He was tossing the ring thoughtfully all the while.

"I'm only a lone trader," said Hank Karns, wistfully, "and don't know no better. Supposing you keep the ring while I'm gone--to appraise it, so to speak. All I want to know is who to call for when I get back. _If_ I get back."

The man pocketed the ring.

"Where will the call come from?"

"I dunno. Space, mebbe. Jail, mebbe."

"My radio call is care assistant dockmaster, Venusberg sky-yard. Mention berth twenty-three somehow. As to the jail angle, I do not as a general thing do business with people in jail. In that event, I might send you a lawyer, in consideration of this ring. Tell Rashab, the night turn-key--you'll know him by the double scar on his chin--that you want to see Mr. Brown. I can't guarantee he'll go, but if he does, bear in mind he's a very cagy fellow and that Venusberg jail is studded with dictaphones and scanners. If what you have in mind smacks at all of illegality, it's likely he'll walk out on you."

"Yep," snapped Hank Karns, beginning to shut the clasps on his slicker, "I'll remember. Only I don't think it'll be a lawyer I'll need. If the

joint is lousy with spy-machines, what I'll want is an old friend--a man of my type."

The man, whatever his name was, for he had still not given it, laughed outright for the first time. He slapped the Lone Trader on the back.

"Men of your type, you old humbug, are extinct as the horse."

Hank Karns looked up to laugh back at him, but he was gone. In his place stood the turbanned Venutian, still doing washing motions with his hands.

"Milord no like vickvare? Milord go now?"

"My Lord, yes. I go now."

Karns jammed on his sou'wester, took a deep breath, and pushed open the door. A half hour later he was making ready for the take-off for Mercury. It was a shot in the dark, but it was a chance he had to take.

"To hell with that," thought Hank Karns. Then briskly to the boy he had brought with him this trip as a general utility man, "Hey, Billy, look alive! Bear a hand with getting them there rakes stowed!"

* * * * *

"So that's Mercury," exclaimed Billy Hatch, four days later, as he stared goggle-eyed into the visiplat. This was his first interplanetary trip.

"Yep," said Karns, "That's her, the doggonedest planet barrin' none in the whole dad-frazzled system. After you've been here you can tell 'em you've seen wind blow, and I mean blow. That's what them rakes is for. To get around you lie down on your belly and pull yourself along by them. It's a helluva place. The sun on your back'd fry you, 'cepting there's always a ice-cold hurricane cooling you off."

"How can that be, cap'n?"

"Convection's the ten-sol word for it. It's cause she's sizzling hot on one side and colder'n the underside of a iceberg on t'other. The wind goes straight up over the desert and comes straight down over the back side glaciers. Then it scoots for the desert again--and how! Nobody could live an hour in any part of the place if it warn't for

the temp'rate strip, and that's cockeyed enough. You gotta steady, hundred-two-hundred-mile wind going straight into the sun, for that's right down to the horizon. In the lee of a house you burn up, in the shade of it you'd freeze solid in five minutes. And the houses have to be stone and streamlined."

Hank Karns kept a watchful eye on the terrain coming up to meet them. Mooring a ship in that wind required the utmost art.

"As I told you, itsa helluva place. Nuthing grows there but a sort of grass and some moss. The only animals is varmints, like the cangrela and the trocklebeck. It's cangrela claws and trocklebeck hides we trade for."

Billy Hatch listened, wide-eyed. This was romance.

"The trocklebeck is a critter something on the order of a armadillo, only it's got horns and big claws to hang onto the ground. It grazes, with its head allus into the wind. The cangrela is built along the lines of a crab and has claws, too. It crawls up behind the trocklebeck and kills 'em while they're feeding. Trocklebeck scales and cangrela claws are both harder'n hell. They use 'em in machinery."

"Oh," said Billy Hatch.

"But you better git forrard there and tend to them grapples, 'cause a-gitting hold of the ground here is ticklish business. Ef we miss it's just too bad. We'll roll over and over for miles and miles, like as not."

Hank Karns said no more for a time. As a matter of fact, he was far from ready to land. He had deliberately come up on the wrong side of the planet for making the landing at Sam Atkins' little trading store. He wanted to give it a general bird's-eye view. It was in a valley scooped out by the wind that he saw the first sign of a major alteration. Behind a huge artificial wind-break lay a group of new buildings, and one of them was dome-topped with a squat chimney. A matter of ten miles farther away was another new house and a small warehouse behind it. Just over the next low ridge lay Atkins' place.

"Standby," warned Hank Karns, as he brought the ship's nose into the hurricane and began losing altitude. "Don't let go 'til I tell you--and that'll be when we're practically down."

Just as the keel kissed the ground, Karns gave the signal and the anchors fell. At the same instant he cut his rockets and the ship began falling away to leeward, dragging her anchors behind. In a moment they grabbed, pulled loose and grabbed again. That time they held. Karns released a long pent-up sigh. It was a perfect landing. Sam Atkins' house lay but a bare hundred yards on the quarter.

There was still the business of shooting a wire over the trading post and making it fast at both ends, Atkins coming out to do his share. Then Captain Karns slid down the wire to the shack and allowed himself to be hauled in by the trading post keeper.

"I'm glad to see you, Cap'n, and sorry at the same time," was his greeting from Sam Atkins. Atkins was a grumpy sort and a self-made hermit. He seemed to enjoy the solitude of windswept Mercury and the tedious, strenuous work of snaring cangrelas.

"How come sorry, Sam?" asked Hank Karns, as innocently as if he had never visited Venus.

Atkins looked mournfully at him and jerked a thumb eastward.

"I've got neighbors--bad ones. Whatever you do, don't go over there. They'll trick you somehow. They don't want outsiders coming here, they've got a ship of their own that makes a trip every week or so."

Hank Karns raised his eyebrows.

"Trocklebecks must be breeding faster'n they used to," he observed. "Mercury never produced enough to justify more than two trips a year, if that."

"Trocklebecks," stated Atkins, "are practically extinct. And the cangrelas are starving. I doubt if I could scare up four cases of prime claws to save my soul. It's _pagras_ that's doing it. The place is crawling with them. They bite the trockelbecks and they curl up and die."

"Mmm," commented Hank Karns. He remembered those serpents well. They were originally a Venusian beast--a variety of dragon, and extremely venomous. They were really legged snakes, having thirty-six pairs of taloned legs and crab-like claws near the head, but the body was slender, rarely exceeding a yard in girth, for all their thirty-foot lengths.

"I'm closing up shop here," said the gloomy Atkins next. "You can take the pick of what I own if you'll set me down at the next stop you make."

"Now you just keep your shirt on, Sam Atkins," replied Hank Karns, "I'm not a-doing anything of the damn kind. I'm going over and have a talk with those gents in the next valley...."

Sam Atkins glared at him.

"No fool like an old fool," he remarked, hopelessly.

Hank Karns chuckled.

"Seems folks are agreed pretty well about me. But let's eat, so I can get along my way."

Unmooring and getting in the anchors was a troublesome job with only a green boy for a helper, but Hank Karns managed it. At that it was a much easier maneuver to move the ship that mile over the ridge than to try to crawl it in the teeth of a permanent typhoon. Moreover, if there was cargo to take aboard--and Hank Karns felt sure there would be--the ship would have to be moved anyhow. So he took off, circumnavigated the planet, and came up again, this time to the little office building and warehouse next to Atkins' shack. He took good care not to go near the other group of buildings.

As he descended, casting about for a good spot to fling out his grapnels he kept a sharp eye out for signs of life about the buildings. All he saw was a couple of bronzed men, both bald as billiard balls, working over some object in the lee of the warehouse. Upon sighting the descending spaceship one went inside the warehouse and the other caught hold of the guide-wire and let himself be blown down to what appeared to be the office building. The man had on a heavily quilted suit of gray material--quilted so that if he lost his hold and was blown away, he would not bruise himself to death along the ground.

On the fourth try, Hank Karns managed to ground his ship not far from the office door. This time he landed to leeward and had to make his way up-wind by crawling, assisted by a Mercurian "staff," or one of the rakes among his trade goods. As he crawled, he observed he was being watched from a loophole beside the door. But as he drew himself erect, the door opened and a man came out to greet him.

"Hello, Captain," said the man, cordially, "we're very glad to see you. Come in and rest yourself." The man, Karns observed, was dressed in a heavily quilted suit and was breathing heavily. But he had a full head of hair and a luxuriant mustache.

"Howdy, yourself," returned the Lone Trader. "Phew! It's shore dusty hereabouts--I've heard of the place but I never seen it. The far Trojans is my bailiwick and the asteroids in that corner...."

"Really?" said the man, helping his visitor through the door. The office was a single room, and no one else was in it. There was a bottle of violet-hued liquor on the table and two glasses. "Have a drink? This is home brew--our Mercurian version of comet-dew--made from flowers that grow under the glacier lips."

"Don't care ef I do," remarked Karns, and sat down in the seat indicated. "As I was saying, I thought I'd look in on this place, seeing as how I had to make the perihelion hop home. Have to git home to see my oldest grandchild married."

"Wouldn't be interested in a bit of cargo, would you?" asked the man. "Our own ship is overdue, and I have some freight for Venus."

"I'm allus interested in a bit of cargo," said Karns, "but this trip I can't stop by Venus--time's too short."

"Oh, well," said his host, indifferently, "it doesn't matter about that. I was thinking of shipping some boxes of claws and hides to our agent at Venusberg for sale there. We are a new company and have no outlets on Terra yet, unless you wanted to speculate on your own account and buy them outright."

"Speculation's my business," said Hank Karns, serene and bland. And added, with just a touch of foxiness, "_ef_ the buying price is right."

"Oh, we won't quarrel about that," laughed the man. "The hides are a by-product with us--this is a pharmaceutical outfit. We make a preparation from the hormones of these beasts. You can have the horns at almost any price."

They spent the better part of an hour in good natured haggling, the child-like old man raising first one trivial objection after another to win small advantages--chiefly in the matter of valuation of the various items of trade goods he had to offer. None of the lone traders ever

dealt in cash. The _Swapper_ was most appropriately named.

At last they shook on the bargain--and a bargain it most obviously was from the trader's point of view. Mr. Raoul Dement, or so the company man styled himself, presented the visiting captain two flasks of the violet liquor after the old custom of the trade.

"Nice stuff," observed Hank Karns, licking his lip. "The best I ever."

"There's twelve cases of it in the warehouse," said Dement, with a wink. "Now, if you were the smuggling sort, there would be a nice profit for you. But, of course...."

"Hell," exploded Hank Karns, "running comet-dew's no sin. Wisht I had a decimo for every gallon I've hauled. Once in a coon's age I get stuck with a little fine, but shucks--the customer'll allus pay that for you."

There followed more dickering, but the upshot of it was that Hank Karns signed up for everything that had been offered him.

"Bon voyage," said Mr. Dement. "If you ever pass this way again, drop in and visit."

"Sure will," said Hank Karns, looking his man in the eye. He was interested in his host's forehead. About an inch from the right temple there was a slight depression--the ineradicable scar of an old skull injury.

* * * * *

Mercury was still a big disk behind when the _Swapper_ straightened out on her earthward trajectory.

"Step alive there, Billy, we got lots to do."

All the blandness, all the gullibility and child-like faith were gone from Hank Karns' face now. He looked much more like work-ridden gnome than an emaciated Santa Claus. For they had unpacked every case and strewn its contents on the deck, looking for contraband of a more serious nature than the harmless comet-dew. But no case contained anything except what the invoice declared. Hank left the job of repacking to the boy and went about a minute search of the ship itself.

In that he was not a moment too soon. Behind the control board--hidden under the vine-like mass of electric leads--were two thermobombs. Their detonating coils were already hot. The control board was divided into three panels, each controlling an opposite pair of the six tubes which were arranged hexagonally about the stern. Two of the panels were about to be ruined by fire.

Hank Karns' first impulse was to snatch the bombs loose and let them burn out harmlessly on the deck, but suddenly he checked it. Instead he withdrew his hand and stuck his blistered fingers in his mouth. Then he shouted a warning to Billy Hatch.

"Hey! Stand by for a blast. Bring an extinguisher, quick!"

The boy ran up, but nothing happened for several minutes. Then the two boards flashed fire. They put the fire out, but the damage was done. The _Swapper_ was not nearly up to acceleration. She could never get to Earth at that velocity. She would have to limp into Venus on her two remaining tubes and have yard electricians renew her wiring.

"Pretty neat," said Hank Karns, admiringly, contemplating his ruined controls.

"I did the best I could, Cap'n," said Billy, modestly, thinking the compliment was meant for him.

"You did all right, son," said the skipper. "Supposing you turn in now. I'll do what's left."

Hank Karns did not at once change course for Venus. He was still unsatisfied that he knew all he should know about his ship and its seemingly innocuous cargo. It was too obvious to miss that Dement had ordered the bombs planted to ensure the _Swapper's_ going into Venus. It was an easy guess that the suggestion to take liquor on board was a device to ensure the ship's arrest and the confiscation that was sure to follow, Venusian courts being what they were. But to Hank Karns' suspicious mind there was much more to it than that. In the first place, he could have obviated both. He could have snatched the bombs before they exploded, and he could yet jettison the liquor. Moreover, if the mere elimination of all visitors to Mercury was what they were after, those bombs could just as well have been of feroxite and designed to destroy the ship entirely, as was done in the case of the openly hostile Merrill and Carter. No, the master plot required the _Swapper_ to go into Venus and be done away with there. Why? He thought

that over.

Suddenly he arose and unlocked his little safe. From its lead container he withdrew a small pellet of radium and set up his fluoroscope. Then he dragged out one of the trockelbeck hides. He searched it systematically from horn to stubby tail, from the scaly back to the claws of the feet. Then he put his fluoroscope away. Grinning into his beard, he went aft and got a pair of pliers, a hammer and a cold chisel.

One of the horns came away as he screwed it off. He knew already from its fluorescence that it was hollowed out and filled with some substance, but he wanted to make sure. He shook the pale green powder inside out into his palm and sniffed it. Yes, that was it. There was the unmistakable odor of crushed cherries and the sickish sweetness of the hashish of the skies--trilibaine! Ah, now he was getting somewhere. And as he split a few back scales at random he found that each had a few grams of the insidious drug within it. One such hide would supply a retail peddler for many months, each scale a separate delivery.

He delayed no longer. He shifted his course toward Venus and at the same time sat down to his radio key. He sent:

"URGENT: Venusberg Sky Yard. Attention assistant dockmaster. Four tubes disabled account switchboard fire. Please reserve for me berth twenty-three. Litigation in prospect. Can you recommend lawyer? (signed) Hank Karns, captain, TS Swapper."

"Well," he said to himself as he carefully swept up the tell-tale green dust from the deck and added it to the bundle of broken scales and neatly bored and threaded horns preparatory to firing it all through the garbage tube into his wake, "I've shot my wad. Now let's see how smart Mr. Brown turns out to be."

* * * * *

He learned very soon that the thermobombs were but an added precaution. He had not been waiting more than a couple hours when his loudspeaker began to buzz. He glanced at it in surprise, as he was still a long way from Venus. The message began coming through, harsh and peremptory, "Lay to, _Swapper_, to receive a boarding party. Lay to, or take the consequences. Sky-guard calling. Lay to!"

Hank Karns cut his rockets and went to the airlock to await the arrival

of the cruiser. It was not long in coming.

Two smartly uniformed young officers sprang in.

"Let's see your manifest," ordered one, curtly, while the other headed for the hold. In a moment the second came back with two flasks of the pale violet comet-dew.

"The old boy is lousy with the stuff," he reported to the other. "Cases and cases of it."

"Yes," said the first, "and not a damn word about it in the manifest. This makes the second one of these old coots we've hauled up this month--what do you say, shall we call this one conspiracy?"

"Why not?" countered the other.

Karns said nothing beyond the usual blustering protests that would be expected of him. Then he lapsed into silence as the two took over after ordering their own vessel to proceed.

They did not go to the commercial sky-yard, but to the official one. Other officers met them, and Hank Karns was led straight away to jail. He protested every step of the way, demanding to be taken before the Terrestrial resident commissioner, or to be booked in the usual way. Both those demands were refused, whereupon he asked for a lawyer.

"Don't kid yourself, old man," said one of his guards. "You're in Venus now. Here you are."

[Illustration: Ray-gun levelled, the guard shoved Hank stumblingly forward. He staggered and nearly fell, striking his head against the barred window. Outside he could see the form of a spaceship. But it was not the _Swapper_. The guard laughed and swaggered out.]

There he was. There was no question about that. The barred door slammed behind his departing escort with an air of utter finality.

"Hi-ya, pop!" screamed some hoodlum down the corridor. "Whatcha in for?"

After that nothing happened. Hank Karns looked about him at his cramped cell and settled down to make the best of it. It would be tiresome, locked up alone this way, but in a day or so perhaps the mysterious Mr. Brown would put in his appearance.

The next day came, but no Mr. Brown. However, early in the morning another visitor came in his place. Karns heard footsteps approaching and the jangle of keys. His door was flung open and a tall stranger stepped in. The man was quite old and clad in the blue uniform, faded and patched, of a space skipper. He was obviously a lone trader, but if he was, he was the only one in the universe that Hank Karns did not know. For this man, with his beetling gray eyebrows and hard steely eyes beneath, he had never laid eyes on before.

"Two minutes, no more," warned the guard, and stood back in the corridor where he could both see and hear.

"Howdy Hank," said the newcomer. "Danged if it ain't gitting so that Tom Bagley spends half his time bailing you out or paying fines. Why, I'd hardly landed here but what I heard you'd been slung into the calaboose again, and I says to myself, says I...."

"Yeah, Tom, I know," said Hank Karns, penitently, trying not to look at the eavesdropping guard. Inwardly he was seething with doubt and curiosity. Could it be that this was some minion of the collector trying to trick him, or was he acting for Mr. Brown? He remembered telling the fellow in the wickerware place that what he really needed was a man of his own type. Maybe they had found one. At any rate, he chose to pretend he knew him.

"Anyhow," went on the stranger, "I looked up a feller named Brown that I know here and asked him what to do. He said things looked pretty black and his advice was to plead guilty and say nothing. Might get off with a fine or something. And that he had a little money of yours. He got me this pass, but said he couldn't work it twice. Now tell me, Hank, what do you want me to do? I gotta get out of here for Mercury in a day or so."

Hank Karns looked at the man steadily for a moment. He was on the spot. The man was evidently from Brown, but he knew neither of them personally. But worse, the guard was listening to every word, and there were doubtless dictaphones as well. But the two minutes were running out and there would not be a second visit.

"I'll tell you, Tom, there isn't but one thing you can do. I'll have to take my medicine, I guess, but I hate like everything to lose them trocklebeck hides and horns. The critters is dying off--poisoned by pagras. Them danged snakes are all over Mercury. You might not have

money enough to buy 'em in, but sorta keep track of 'em, won't you? They're not worth much now, but they'll be _mighty_ valuable some day. There's a man here from Io that'll pay a good price for 'em, ef you can find him."

"Time's up," snapped the guard, coming forward.

"All right, you old scalawag," said the phony trader captain, jovially, "I'll do my best. But watch your step with that jedge. He's tough."

"I know," said Hank Karns, despondently, and settled his face in his hands.

The door slammed and the footsteps withdrew, ringing emptily down the metal passage.

Dreary day followed dreary day. Time after time Karns heard footsteps ringing in the corridor, and as often he heard the rattle of keys as some door was opened and another unfortunate was ordered out to meet his doom--the sentence that was to change his state from slow dry rot to the swift wet rot of the Swamp. But it was never Karns' door.

Then at last came the day when guards took him to the identical court where Wilkerson had been tried. The evidence was brief and to the point. He was apprehended trying to sneak into Venus when his clearance papers called for Terra as his destination. He had on board eight cases of illicit liquor. He had no acceptable explanation. Guilty. Two years in the Swamp and the loss of his ship was the sentence. Then they took him back to his cell to await the next caravan to the penal camps.

The second stretch of waiting was harder to take than the first, for he had placed the enigmatic collector now in his memory. The man was Von Kleber, thought to have died many years ago in the uranium mines of Sans Espérance. Karns knew him to be a convict from the fact that he had grafted new skin on his face and head so that the burns and baldness caused by radioactivity would not show. But that he was the notorious Von Kleber himself had not occurred to him. And with that recognition came the other. Raoul Dement was the man known as Frenchy the Hop, vice-president of the Von Kleber ring. It was he who had operated the narcotic racket while the big boss turned his attention to such other lines as piracy, white-slaving and smuggling in general. If such men could flourish unchecked in the well-policed Jovian satellites for more than a decade, it was hopeless to expect to dislodge them from their place on corrupt and autonomous Venus.

And so time dragged on and Hank Karns sat, awaiting the day when he would be taken away to the Swamp. He wondered apathetically whether he would be sent to the same camp where Wilkerson and Hildreth were. But at last there came a day when footsteps rang again in the corridors and he heard doors being opened and men taken away. Finally men stopped before his own cell and called him forth. Between two soldiers they marched him away.

To his surprise they took him first to the street, where three sedan chairs were waiting. The guards very politely indicated that Karns was to get in the middle one and they took the others. Hank clambered in and they set off. Shortly they drew up before the courthouse.

He was met inside by a tall, slender man of nearly his own age who wore the uniform of Chief Inspector of the Interplanetary F.B.I.

"How are you, Captain?" he said cheerily. "Sorry you had such a long stay in jail, but we'll try to make that up to you. Come in here and let me show you something?"

Hank Karns looked at the inspector in amazement. He was Frank Haynes, the man who had broken the Von Kleber case years before. There had been a time when they worked closely together on the information that Karns furnished when he was released from Sans Espérance. He said nothing in reply, though, as Haynes was leading the way into the courtroom. In the dock were two baldheaded prisoners--Von Kleber, erstwhile Collector of the Port, and Mr. Dement, manager of the Mercurian drug works. The judge was a new one--a judge who looked like a judge should look.

"There they are, thanks to you," said Haynes, pointing. "Two as clever criminals as ever plagued the system. We've been a long time catching them. But their career is over now.

"Our local operative, known as Brown to you, has been trying for months to locate the source of the trilobaine flood but without avail. The Venusian authorities blocked him at every turn but there was nothing we could do about that unless we could hang a Federal offense on them. It was you who did that for us. I am very glad I gave you that identification ring after our cleanup on Callisto and the list of the secret addresses of our agents. I felt then that you were a man of discretion and would not abuse its privileges and today I most certainly am more than justified. When I interviewed you in your cell...."

"You!"

Inspector Haynes grinned at Hank's surprise.

"Pretty effective disguise, eh? Well, as I was about to say--you gave me all the tips that were needed. First of all, your mention of the scourge of pagras told me it was trilobaine you had aboard, for that is a distillation of pagra venom. That gave us jurisdiction. I attended the secret auction and tried to bid. Everything in the ship went for a song to Von Kleber's pals, but when I went to bid on the trocklebeck hides I ran into stiff opposition. They were not to be had at any price. So I stopped bidding.

"Our operatives trailed those hides through five sets of owners before we came to the Collector himself. Early this morning we made our raid and took in all their supplies of drugs and twenty-five of their peddlers. Previously we had raided Mercury and those men came in about an hour ago. They had quite a thriving little business, and why we didn't think of their method of smuggling in the trilobaine before this I'll never know. We knew, of course, that it must be coming in the ships that they confiscated. That much we were sure of. But we couldn't prove a damn thing until we knew how. Thanks to you, the ring is busted now, and we can do something for those poor devils who were innocently duped into being carriers of the drug. Runners have already been sent to the Swamp to bring back your friends. And there you are. You'll find your old Swapper in the Yard, completely overhauled and stocked to the gunwales with grade A trade goods."

Hank Karns, trader, tugged at his grizzled beard and looked rather sheepishly at the floor.

"Dag it all," he said "that's fine enough. But gosh, I sure hated to make a damfool of myself in front of everybody thataway."

Inspector Haynes broke into laughter and crossed over and slapped him on the back.

"You old liar. You loved it!"

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SPACECRAFT STERILIZATION

The Project Gutenberg EBook [#40268] of
Significant Achievements in Space Bioscience 1958-1964,
by National Aeronautics and Space Administration

The search for extraterrestrial life with unmanned space probes requires the total sterilization of the landing capsule and its contents. Scientists agree that terrestrial organisms released on other planets would interfere with exobiological explorations (refs. [ref.36]-[ref.43]). Any flight that infects a planet with terrestrial life will compromise a scientific opportunity of almost unequaled proportions. Studies on microbiological survival in simulated deep-space conditions (low temperature, high ultraviolet flux, and low dose levels of ionizing radiation) indicate that these conditions will not sterilize contaminated spacecraft (refs. [ref.44]-[ref.48]). Furthermore, many terrestrial sporeformers and some vegetative bacteria, especially those with anaerobic growth capabilities, readily survive in simulated Martian environments (refs. [ref.49]-[ref.54]). It has been estimated that a single micro-organism with a replication time of 30 days could, in 8 years of such replication, equal in number the bacterial population of the Earth. This potential could result not only in competition with any Martian life, but in drastic changes in the geochemical and atmospheric characteristics of the planet. To avoid such a disaster, certainly the first, and probably many succeeding landers on Mars, must be sterile—devoid of terrestrial life ([ref.55]). Since the space environment will not in itself kill all life aboard, the lander must leave the Earth in a sterile condition.

The sterility of an object implies the complete absence of life. The presence of life or the lack of sterility may be proven; but the absence of life or sterility cannot be proven, for the one viable organism that negates sterility may remain undetected. Many industrial products which must be guaranteed as sterile cannot be tested for sterility in a nondestructive manner. A similar situation exists in determining the sterility of a spacecraft. Certification of sterility—based on experience with the sterilizing process used, knowledge of the kinetics of the death of micro-organisms, and computation of the probability of a survivor from assays for sterility—is the only accurate approach to defining the sterility of such treated items.

Macroscopic life can be readily detected and kept from or removed from the spacecraft, but the detection and removal of microscopic and

submicroscopic life is an extremely difficult task. The destruction of micro-organisms can be achieved by various chemical and physical procedures. Sterilizing agents have been evaluated not only for their ability to kill microbial life on surfaces and sealed inside components, but also for the agents' effects on spacecraft reliability as well (refs. [ref.56]-[ref.59]). Of the available agents, only heat and radiation will penetrate solid materials. Radiation is expensive, hazardous, difficult to control, and apparently damages more materials than does heat. Heat, therefore, has been selected as the primary method of spacecraft sterilization and will be used, except in specific instances where radiation may prove to be less detrimental to the reliability of critical parts ([ref.60]).

The sterilization of spacecraft is a difficult problem if flight reliability is not to be impaired. The development of heat-resistant parts will enable the design and manufacture of a heat-sterilizable spacecraft. Without careful microbiological monitoring of manufacture and assembly procedures, many bacteria could be trapped in parts and subassemblies. To permit sterilization at the lowest temperature-time regimen that will insure kill of all organisms, the microbiological load inside all parts and subassemblies must be held to a minimum.

The role of industrial clean rooms in reducing the biological load on spacecraft is currently being defined. NASA-supported studies indicate that biological contamination in industrial clean rooms for extended time periods is about 1 logarithm less (tenfold reduction), compared with conditions in a well-operated microbiological laboratory ([ref.61]). With the use of clean-room techniques and periodic decontamination by low heat cycles or ethylene oxide treatment, it should be possible to bring a spacecraft to the point of sterilization with about 10^6 organisms on board ([ref.60]).

The sterilization goal established for Mars landers is a probability of less than 1 in 10 000 (10^{-4}) that a single viable organism will be present on the spacecraft. Laboratory studies of the kinetics of dry-heat kill of resistant organisms show that at 135°C the number of bacterial spores can be reduced 1 logarithm (90 percent) for every 2 hours of exposure (refs. [ref.58] and [ref.62]). The reduction in microbial count needed is the logarithm of the maximum number on the spacecraft (10^6) plus the logarithm of the reciprocal of the probability of a survivor (10^4), or a total of 10 logarithms of reduction in microbial count. Thus, with an additional 2 logarithms added as a safety factor, a total of 12 logarithms of reduction in count has been accepted as a safe value which can be achieved by a dry-heat treatment of 135°C

for 24 hours. This is the heat cycle that is currently under study and being developed for use in spacecraft sterilization ([ref.60]). However, other heat treatments at temperatures as low as 105° C for periods of 300 hours or longer are under study ([ref.63]).

Based on results to date, it is reasonable to believe that a full complement of heat-sterilizable hardware will be available when needed for planetary exploration. Every effort is being made to improve the state of the art to a point where spacecraft can not only withstand sterilization temperatures, but will be even more reliable than the present state-of-the-art hardware that is not heated.

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Charlotte Gilman, 1900

CHAPTERS I & 2 OF

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Moving the Mountain, by Charlotte Perkins Gilman

CHAPTER I

On a gray, cold, soggy Tibetan plateau stood glaring at one another two white people--a man and a woman.

With the first, a group of peasants; with the second, the guides and carriers of a well-equipped exploring party.

The man wore the dress of a peasant, but around him was a leather belt--old, worn, battered--but a recognizable belt of no Asiatic pattern, and showing a heavy buckle made in twisted initials.

The woman's eye had caught the sunlight on this buckle before she saw that the heavily bearded face under the hood was white. She pressed forward to look at it.

"Where did you get that belt?" she cried, turning for the interpreter to urge her question.

The man had caught her voice, her words. He threw back his hood and looked at her, with a strange blank look, as of one listening to something far away.

"John!" she cried. "John! My Brother!"

He lifted a groping hand to his head, made a confused noise that ended in almost a shout of "Nellie!" reeled and fell backward.

* * * * *

When one loses his mind, as it were, for thirty years, and finds it again; when one wakes up; comes to life; recognizes oneself an American citizen twenty-five years old----

No. This is what I find it so hard to realize. I am not twenty-five; I am fifty-five.

* * * * *

Well, as I was saying, when one comes to life again like this, and has to renew acquaintance with one's own mind, in a sudden swarming rush of hurrying memories--that is a good deal of pressure for a brain so long unused.

But when on top of that, one is pushed headlong into a world immeasurably different from the world one has left at twenty-five--a topsy-turvy world, wherein all one's most cherished ideals are found to be reversed, re-arranged, or utterly gone; where strange new facts are accompanied by strange new thoughts and strange new feelings--the

pressure becomes terrific.

Nellie has suggested that I write it down, and I think for once she is right. I disagree with her on so many points that I am glad to recognize the wisdom of this idea. It will certainly be a useful process in my re-education; and relieve the mental tension.

So, to begin with my first life, being now in my third----

* * * * *

I am the only son of a Methodist minister of South Carolina. My mother was a Yankee. She died after my sister Ellen was born, when I was seven years old. My father educated me well. I was sent to a small Southern college, and showed such a talent for philology that I specialized in ancient languages, and, after some teaching and the taking of various degrees, I had a wonderful opportunity to join an expedition into India and Tibet. I was eager for a sight of those venerable races, those hoary scriptures, those time-honored customs.

We were traveling through the Himalayas--and the last thing I remember was a night camp, and a six-months-old newspaper from home. We had rejoicingly obtained it from a party we met in the pass.

It was read and re-read by all of us--even the advertisements--even the editorials, and in one of these I learned that Mrs. Eddy had been dead some time and that another religion had burst forth and was sweeping the country, madly taken up by the women. That was my last news item.

I suppose it was this reading, and the discussions we had, that made me walk in my sleep that night. That is the only explanation I can give. I know I lay down just as I was--and that's all I know, until Nellie found me.

* * * * *

The party reported me lost. They searched for days, made what inquiry they could. No faintest clue was ever found. Himalayan precipices are very tall, and very sudden.

* * * * *

My sister Nellie was traveling in Tibet and found me, with a party of peasants. She gathered what she could from them, through interpreters.

It seems that I fell among those people--literally; bruised, stunned, broken, but not dead. Some merciful--or shall I say unmerciful?--trees had softened the fall and let me down easy, comparatively speaking.

They were good people--Buddhists. They mended my bones and cared for me, and it appears made me quite a chief man, in course of time, in their tiny village. But their little valley was so remote and unknown, so out of touch with any and everything, that no tale of this dumb white man ever reached Western ears. I was dumb until I learned their language, was "as a child of a day," they said--knew absolutely nothing.

They taught me what they knew. I suppose I turned a prayer mill; I suppose I was married--Nellie didn't ask that, and they never mentioned such a detail. Furthermore, they gave so dim an account of where the place was that we don't know now; should have to locate that night's encampment, and then look for a precipice and go down it with ropes.

As I have no longer any interest in those venerable races and time-honored customs, I think we will not do this.

Well, she found me, and something happened. She says I knew her--shouted "Nellie!" and fell down--fell on a stone, too, and hit my head so hard they thought I was dead this time "for sure." But when I "came to" I came all the way, back to where I was thirty years ago; and as for those thirty years--I do not remember one day of them.

Nor do I wish to. I have those filthy Tibetan clothes, sterilized and packed away, but I never want to look at them.

I am back in the real world, back where I was at twenty-five. But now I am fifty-five----

* * * * *

Now, about Nellie. I must go slowly and get this thing straightened out for good and all.

My little sister! I was always fond of her, and she adored me. She looked up to me, naturally; believed everything I told her; minded me like a little dog--when she was a child. And as she grew into girlhood, I had a strong restraining influence upon her. She wanted to be educated--to go to college--but father wouldn't hear of it, of course, and I backed him up. If there is anything on earth I always hated and

despised, it is a strong-minded woman! That is--it _was_. I certainly cannot hate and despise my sister Nellie.

Now it appears that soon after my departure from this life father died, very suddenly. Nellie inherited the farm--and the farm turned out to be a mine, and the mine turned out to be worth a good deal of money.

So that poor child, having no natural guardian or protector, just set to work for herself--went to college to her heart's content, to a foreign university, too. She studied medicine, practiced a while, then was offered a chair in a college and took it; then--I hate to write it--but she is now president of a college--_a co-educational college_!

"Don't you mean 'dean?'" I asked her.

"No," she said. "There is a dean of the girl's building--but I am the president."

My little sister!

* * * * *

The worst of it is that my little sister is now forty-eight, and I--to all intents and purposes--am twenty-five! She is twenty-three years older than I am. She has had thirty years of world-life which I have missed entirely, and this thirty years, I begin to gather, has covered more changes than an ordinary century or two.

It is lucky about that mine.

"At least I shall not have to worry about money," I said to her when she told me about our increased fortune.

She gave one of those queer little smiles, as if she had something up her sleeve, and said:

"No; you won't have to worry in the least about money."

* * * * *

Having all that medical skill of hers in the background, she took excellent care of me up there on those dreary plains and hills, brought me back to the coast by easy stages, and home on one of those new steamers--but I mustn't stop to describe the details of each new thing I

notice!

I have sense enough myself, even if I'm not a doctor, to use my mind gradually, not to swallow too fast, as it were.

Nellie is a little inclined to manage me. I don't know as I blame her. I do feel like a child, sometimes. It is so humiliating not to know little common things such as everybody else knows. Air ships I expected, of course; they had started before I left. They are common enough, all sizes. But water is still the cheaper route--as well as slower.

Nellie said she didn't want me to get home too quick; she wanted time to explain things. So we spent long, quiet hours in our steamer chairs, talking things over.

It's no use asking about the family; there is only a flock of young cousins and "once removed" now; the aunts and uncles are mostly gone. Uncle Jake is left. Nellie grins wickedly when she mentions him.

"If things get too hard on you, John, you can go down to Uncle Jake's and rest up. He and Aunt Dorcas haven't moved an inch. They fairly barricade their minds against a new idea--and he ploughs and she cooks up on that little mountain farm just as they always did. People go to see them----"

"Why shouldn't they?" I asked. And she smiled that queer little smile again.

"I mean they go to see them as if they were the Pyramids."

"I see," said I. "I might as well prepare for some preposterous nightmare of a world, like--what was that book of Wells', 'The Sleeper Awakened?'"

"Oh, yes; I remember that book," she answered, "and a lot of others. People were already guessing about things as they might be, weren't they? But what never struck any of them was that the people themselves could change."

"No," I agreed. "You can't alter human nature."

Nellie laughed--laughed out loud. Then she squeezed my hand and patted it.

"You _Dear_!" she said. "You precious old Long-Lost Brother! When you get too utterly upset I'll wear my hair down, put on a short dress and let you boss me awhile--to keep your spirits up. That was just the phrase, wasn't it?--'You can't alter human nature!'" And she laughed again.

There is something queer about Nellie--very queer. It is not only that she is different from my little sister--that's natural; but she is different from any woman of forty-eight I ever saw--from any woman of any age I ever saw.

In the first place, she doesn't look _old_--not at all. Women of forty, in our region, were _old women_, and Nellie's near fifty! Then she isn't--what shall I call it--dependent; not the least in the world. As soon as I became really conscious, and strong enough to be of any use, and began to offer her those little services and attentions due to a woman, I noticed this difference.

She is brisk, firm, assured--not unpleasantly so; I don't mean a thing of that sort; but somehow like--almost like a man! No, I certainly don't mean that. She is not in the least mannish, nor in the least self-assertive; but she takes things so easily--as if she owned them.

* * * * *

I suppose it will be some time before my head is absolutely clear and strong as it used to be. I tire rather easily. Nellie is very reassuring about it. She says it will take about a year to re-establish connections and renew mental processes. She advises me to read and talk only a little every day, to sleep all I can, and not to worry.

"You'll be all right soon, my dear," she says, "and plenty of life before you. You seem to have led a very healthy out-door life. You're really well and strong--and as good-looking as ever."

At least she hasn't forgotten that woman's chief duty is to please.

"And the world is a much better place to have in than it was," she assured me. "Things will surprise you, of course--things I have gotten used to and shall forget to tell you about. But the changes are all good ones, and you'll soon get--acclimated. You're young yet."

That's where Nellie slips up. She cannot help having me in mind as the brave young brother she knew. She forgets that I am an old man now.

Finally I told her that.

"No, John Robertson," she says, "that's where you are utterly wrong. Of course, you don't know what we're doing about age--how differently we feel. As a matter of physiology we find that about one hundred and fifty ought to be our natural limit; and that with proper conditions we can easily get to be a hundred now. Ever so many do."

"I don't want to be a hundred," I protested. "I saw a man of ninety-eight once, and never want to be one."

"It's not like that now," she said. "I mean we live to be a hundred and enjoy life still--'keep our faculties,' as they used to put it. Why, the ship's doctor here is eighty-seven."

This surprised me a good deal. I had talked a little with this man, and had thought him about sixty.

"Then a man of a hundred, according to your story, would look like--like----"

"Like Grandpa Ely," she offered.

I remembered my mother's father--a tall, straight, hale old man of seventy-five. He had a clear eye, a firm step, a rosy color in his face. Well, that wasn't so bad a prospect.

"I consent to be a hundred--on those terms," I told her.

* * * * *

She talked to me a good bit, in small daily doses, of the more general changes in the world, showed me new maps, even let me read a little in the current magazines.

"I suppose you have a million of these now," I said. "There were thousands when I left!"

"No," she answered. "There are fewer, I believe; but much better."

I turned over the one in my hand. It was pleasantly light and thin, it opened easily, the paper and presswork were of the best, the price was twenty-five cents.

"Is this a cheap one--at a higher price? or have the best ones come down?"

"It's a cheap one," she told me, "if you mean by that a popular one, and it's cheap enough. They have all of a million subscribers."

"And what's the difference, beyond the paper and print?" I asked.

"The pictures are good."

I looked it through again.

"Yes, very good, much improved. But I don't see anything phenomenal--unless it is the absence of advertisements."

Nellie took it out of my hand and ran it over.

"Just read some of that," she said. "Read this story--and this article--and that."

So I sat reading in the sunny silence, the gulls wheeling and dipping just as they used to, and the wide purple ocean just as changeable--and changeless--as ever.

One of the articles was on an extension of municipal service, and involved so much comment on preceding steps that I found it most enlightening. The other was a recent suggestion in educational psychology, and this too carried a retrospect of recent progress which gave me food for thought. The story was a clever one. I found it really amusing, and only on a second reading did I find what it was that gave the queer flavor to it. It was a story about women--two women who were in business partnership, with their adventures, singly and together.

I looked through it carefully. They were not even girls, they were not handsome, they were not in process of being married--in fact, it was not once mentioned whether they were married or not, ever had been or ever wanted to be. Yet I had found it amusing!

I laid the magazine on my rug-bound knees and meditated. A queer sick feeling came over me--mental, not physical. I looked through the magazine again. It was not what I should have called "a woman's magazine," yet the editor was a woman, most of the contributors were women, and in all the subject matter I began to detect allusions and references of tremendous import.

Presently Nellie came to see how I was getting on. I saw her approaching, a firm, brisk figure, well and becomingly dressed, with a tailored trimness and convenience, far indeed from the slim, graceful, yielding girl I had once been so proud to protect and teach.

"How soon do we get in, Lady Manager?" I asked her.

"Day after to-morrow," she answered back promptly--not a word about going to see, or asking anyone!

"Well, ma'am, I want you to sit down here and tell me things--right now. What am I to expect? Are there _no_ men left in America?"

She laughed gaily.

"No men! Why, bless you, there are as many men as there are women, and a few more, I believe. Not such an over-plus as there used to be, but some to spare still. We had a million and a half extra in your day, you know."

"I'm glad to learn we're allowed to live!" said I. "Now tell me the worst--are the men all doing the housework?"

"You call that 'the worst,' do you?" inquired Nellie, cocking her head to one side and looking at me affectionately, and yet quizzically.

"Well, I guess it was--pretty near 'the worst!' No dear, men are doing just as many kinds of business as they ever were."

I heaved a sigh of relief and chucked my magazine under the chair.

"I'd begun to think there weren't any men left. And they still wear trousers, don't they?"

She laughed outright.

"Oh, yes. They wear just as many trousers as they did before."

"And what do the women wear," I demanded suspiciously.

"Whatever kind of clothing their work demands," she answered.

"Their work? What kind of work do they do?"

"All kinds--anything they like."

I groaned and shut my eyes. I could see the world as I left it, with only a small proportion of malcontents and a large majority of contented and happy homes; and then I saw this awful place I was coming to, with strange, masculine women and subdued men.

"How does it happen that there aren't any on this ship?" I inquired.

"Any what?" asked Nellie.

"Any of these--New Women?"

"Why, there are. They're all new, except Mrs. Talbot. She's older than I am, and rather reactionary."

This Mrs. Talbot was a stiff, pious, narrow-minded old lady, and I had liked her the least of any on board.

"Do you mean to tell me that pretty Mrs. Exeter is--one of this new kind?"

"Mrs. Exeter owns--and manages--a large store, if that is what you mean."

"And those pretty Borden girls?"

"They do house decorating--have been abroad on business."

"And Mrs. Green--and Miss Sandwich?"

"One of them is a hat designer, one a teacher. This is toward the end of vacation, and they're all coming home, you see."

"And Miss Elwell?"

Miss Elwell was quite the prettiest woman on board, and seemed to have plenty of attention--just like the girls I remembered.

"Miss Elwell is a civil engineer," said my sister.

"It's horrid," I said. "It's perfectly horrid! And aren't there any women left?"

"There's Aunt Dorcas," said Nellie, mischievously, "and Cousin Drusilla. You remember Drusilla?"

CHAPTER II

The day after to-morrow! I was to see it the day after to-morrow--this strange, new, abhorrent world!

The more I considered what bits of information I had gleaned already, the more I disliked what lay before me. In the first blazing light of returned memory and knowledge, the first joy of meeting my sister, the hope of seeing home again, I had not distinguished very sharply between what was new to my bewildered condition and what was new indeed--new to the world as well as to me. But now a queer feeling of disproportion and unreality began to haunt me.

As my head cleared, and such knowledge as I was now gathering began to help towards some sense of perspective and relation, even my immediate surroundings began to assume a sinister importance.

Any change, to any person, is something of a shock, though sometimes a beneficial one. Changes too sudden, and too great, are hard to bear, for any one. But who can understand the peculiar horror of my unparalleled experience?

Slowly the thing took shape in my mind.

There was the first, irrevocable loss--my life!

Thirty years--_the_ thirty years in which a man may really live--these were gone from me forever.

I was coming back; strong to be sure; well enough in health; even, I hoped, with my old mental vigor--_but not to the same world_.

Even the convict who survives thirty years imprisonment, may return at length to the same kind of world he had left so long.

But !! It was as if I had slept, and, in my sleep, they had stolen my world.

I threw off the thought, and started in to action.

Here was a small world--the big steamer beneath me. I had already learned much about her. In the first place, she was not a "steamer," but a thing for which I had no name; her power was electric.

"Oh, well," I thought, as I examined her machinery, "this I might have expected. Thirty years of such advances as we were making in 1910 were sure to develop electric motors of all sorts."

The engineer was a pleasant, gentlemanly fellow, more than willing to talk about his profession and its marvellous advances. The ship was well manned, certainly; though the work required was far less than it used to be, the crew were about as numerous. I had made some acquaintances among the ship's officers--even among the men, who were astonishingly civil and well-mannered--but I had not at first noticed the many points of novelty in their attitude or in my surroundings.

Now I paced the deck and considered the facts I had observed--the perfect ventilation of the vessel, the absence of the smell of cooking and of bilge water, the dainty convenience and appropriate beauty of all the fittings and furnishings, the smooth speed and steadiness of her.

The quarters of the crew I found as remarkable as anything else about the vessel; indeed the forecastle and steerage differed more from what I remembered than from any other part. Every person on board had a clean and comfortable lodging, though there were grades of distinction in size and decoration. But any gentleman could have lived in that "foks'le" without discomfort. Indeed, I soon found that many gentlemen did. I discovered, quite by accident, that one of the crew was a Harvard man. He was not at all loath to talk of it, either--was evidently no black sheep of any sort.

Why had he chosen this work?

Oh, he wanted the experience--it widened life, knowing different trades.

Why was he not an officer then?

He didn't care to work at it long enough--this was only experience work, you see.

I did not see, nor ask, but I inferred, and it gave me again that

feeling as if the ground underfoot had wiggled slightly.

Was that old dream of Bellamy's stalking abroad? Were young men portioned out to menial service, willy-nilly?

It was evidently not a universal custom, for some of the sailors were much older men, and long used to the business. I got hold of one who seemed more like the deckhands of old days, though cleaner and more cheerful; a man who was all of sixty.

Yes he had followed the sea from boyhood. Yes, he liked it, always had liked it, liked it better now than when he was young.

He had seen many changes? I listened carefully, though I asked the question lightly enough.

Changes! He guessed he had. Terbacca was better for one thing--I was relieved to see that men still smoked, and then the jar came again as I remembered that save for this man, and one elderly officer, I had not seen anyone smoking on the vessel.

"How do you account for it?" I asked the old Yankee. "For tobacco's being better?"

He grinned cheerfully.

"Less run on it, I guess," said he. "Young fellers don't seem to smoke no more, and I ain't seen nobody chewing for--well, for ten years back."

"Is it cheaper as well as better?"

"No, sir, it ain't. It's perishing high. But then, wages is high, too," he grudgingly admitted.

"Better tobacco and better wages--anything else improved?"

"Yes, sir-ee! Grub's better, by square miles--and 'commodations--an' close. Make better stuff now.

"Well! well!" said I as genially as I knew how. "That's very different from my young days. Then everybody older than I always complained about all manner of things, and told how much better--and cheaper--things were when they were young."

"Yes, 'twas so," he admitted meditatively. "But 'tain't so now. Shoes is better, most things is better, I guess. Seems like water runnin' up hill, don't it, sir?"

It did. I didn't like it. I got away from the old man, and walked by myself--like Kipling's cat.

"Of course, of course!" I said to myself impatiently, "I may as well expect to find everything as much improved from what it was in my time as in, say, sixty years before. That sort of progress goes faster and faster. Things change, but people--"

And here is where I got this creepy sense of unreality.

At first everything was so strange to me, and my sister was so kind and thoughtful, so exquisitely considerate of my feelings and condition, that I had failed to notice this remarkable circumstance--so were the other people. It was like being in a--well, in a house-party of very nice persons. Kind, cheerful, polite--here I suddenly realized that I had not seen a grouchy face, heard an unkind remark, felt, as one does feel through silk and broadcloth, the sense of discontent and disapproval.

There was one, the somewhat hard-faced old lady, Mrs. Talbot, of whom I had hopes. I sought her, and laid myself out to please her by those little attentions which are so grateful to an elderly woman from a young man.

Her accepting these as a commonplace, her somewhat too specific inquiries about my health, suddenly reminded me that I was not a young man----

She talked on while I made again that effort at readjustment which was so hideously hard. Gone in a night--all my young manhood--gone untasted!

"Do you find it difficult to concentrate your attention?" she was saying, a steely eye fixed upon my face.

"I beg your pardon, madam. I fear I do. You were saying--"

"I was saying that you will find many changes when you get back."

"I find them already, Mrs. Talbot. They rather loom up. It is sudden, you see."

"Yes, you've been away a long time, I understand. In the far East?"

Mrs. Talbot was the first person who had asked me a question. Evidently hers were the manners of an older generation, and for once I had to admit that the younger generation had improved.

But I recalled the old defensive armor against the old assaults.

"Quite a while," I answered cheerfully, "Quite a while. Now what should you think would impress me most--in the way of change?"

"The women," she answered promptly.

I smiled my gallantest, and replied, bowing:

"I find them still charming."

Her set face broke into a pleased smile.

"You do my heart good!" she cried. "I haven't heard a compliment in fifteen years."

"Good Heavens, madam! what are our men thinking of?"

"It's not the men's fault; it's the women's. They won't have it."

"Are there many of these--new women?"

"There's nothing else--except a few old ones like me."

I hastened to assure her that a woman like her would never be called old--and she looked as pleased as a girl.

Presently I excused myself and left her, with relief. It was annoying beyond measure to have the only specimen of the kind of woman I used to like turn out to be personally the kind I never liked.

On the opposite deck, I found Miss Elwell--and for once alone. A retiring back, wearing an aggrieved expression showed that it had not been for long.

"May I join you, Miss Elwell?"

I might. I did. We paced up and down, silent for a bit.

She was a joy to the eye, a lovely, straight, young thing, with a fresh, pure color and eyes of dancing brightness. I spoke of this and that aboard ship--the sea, the weather; and she was so gaily friendly, so sweet and modest, yet wholly frank, that I grew quite happy in her company.

My sister must have been mistaken about her being a civil engineer. She might be a college girl--but nothing worse. And she was so pretty!

I devoted myself to Miss Elwell 'till she took herself off, probably to join her--her--it occurred to me that I had seen no one with Miss Elwell.

"Nellie," said I, "for heaven's sake give me the straight of all this. I'm going distracted with the confusion. What has happened to the world? Tell me all, I can bear it--as the extinct novels used to say. But I cannot bear this terrible suspense! Don't you have novels any more?"

"Novels? Oh, yes, plenty; better than ever were written. You'll find it splendidly worth while to read quite a few of them while you're getting oriented . . . Well, you want a kind of running, historic sketch?"

"Yes. Give me the outlines--just the heads, as it were. You see, my dear, it is not easy to get readjusted even to the old things, and there are so many new ones----"

We were in our steamer chairs, most people dozing after their midday meal. She reached over and took my hand in hers, and held it tight. It was marvelously comforting, this one live visible link between what was forever past and this uncertain future. But for her, even those old, old days might have flickered and seemed doubtful--I should have felt like one swimming under water and not knowing, which way was up. She gave me solid ground underfoot at any rate. Whatever her place might be in this New World, she had talked to me only of the old one.

In these long, quiet, restful days, she had revived in my mind the pleasant memories of our childhood together; our little Southern home; our patient, restrained Northern mother and the fine education she gave her school-less little ones; our high-minded--and, alas, narrow-minded--father, handsome, courteous, inflexible. Under Nellie's gentle leading, my long unused memory-cells had revived like rain-washed leaves, and my past life had, at last, grown clear and steady.

My college life; my old chum, Granger, who had visited us once; our neighbors and relations; little gold-haired Cousin Drusilla, whom I, in ten years proud seniority, had teased as a baby, played with and tyrannized over as a confiding child, and kissed good-bye--a slim, startled little figure--when I left for Asia.

Nellie had always spoken of things as I remembered them, and avoided adroitly, or quietly refused to discuss, their new aspects.

I think she was right--at first.

"Out with it!" said I. "Come--Have we adopted Socialism?" I braced myself for the answer.

"Socialism? Oh--why, yes. I think we did. But that was twenty years ago."

"And it didn't last? You've proved the impracticable folly of it? You've discarded it?"

I sat up straight, very eager.

"Why, no--" said Nellie. "It's very hard to put these new things into old words--We've got beyond it."

"Beyond Socialism! Not--not--Anarchy?"

"Oh, bless you, no; no indeed! We understand better what socialism meant, that's all. We have more, much more, than it ever asked; but we don't call it that."

I did not understand.

"It's like this," she said. "Suppose you had left a friend in the throes of a long, tempestuous' courtship, full of ardor, of keen joy, and keener anticipation. Then, returning, you say to your friend, 'Do you still have courtship?' And he says, 'Why no, I'm married.' It's not that he has discarded it, proved it's impracticable folly. He had to have it--he liked it--but he's got beyond it."

"Go on and elucidate," I said. "I don't quite follow your parable."

She considered a bit.

"Well, here's a more direct parallel. Back in the 18th century, the world was wild about Democracy--Democracy was going to do all things for all men. Then, with prodigious struggles, they acquired some Democracy--set it going. It was a good thing. But it took time. It grew. It had difficulties. In the next century, there was less talk about all the heavenly results of Democracy, and more definite efforts to make it work."

This was clearer.

"You mean," I followed her slowly. "That what was called socialism was attained--and you've been improving upon it?"

"Exactly, Brother, 'you are on'--as we used to say. But even that's not the main step."

"No? What else?"

"Only a New Religion."

I showed my disappointment. Nellie watched my face silently. She laughed. She even kissed me.

"John," said she, "I could make vast sums by exhibiting you to psychologists! as An Extinct Species of Mind. You'd draw better than a Woolly Mammoth."

I smiled wryly; and she squeezed my hand. "Might as well make a joke of it, Old Man--you've got to get used to it, and 'the sooner the quicker!'"

"All right--Go ahead with your New Religion."

She sat back in her chair with an expression of amused retrospection.

"I had forgotten," she said, "I had really forgotten. We didn't use to think much of religion, did we?"

"Father did," said I.

"No, not even Father and his kind--they only used it as a--what was the old joke? a patent fire escape! Nobody appreciated Religion!"

"They spent much time and money on it," I suggested.

"_That's_ not appreciation!"

"Well, come on with the story. Did you have another Incarnation of any body?"

"You might call it that," Nellie allowed, her voice growing quietly earnest, "We certainly had somebody with an unmistakable Power."

This did not interest me at all. I hated to see Nellie looking so sweetly solemn over her "New Religion." In the not unnatural reaction of a minister's son, rigidly reared, I had had small use for religion of any sort. As a scholar I had studied them all, and felt as little reverence for the ancient ones as for the shifty mushroom crop of new sects and schools of thought with which the country teemed in my time.

"Now, look here, John," said she at length, "I've been watching you pretty closely and I think you're equal to a considerable mental effort--In one way, it may be easier for you, just because you've not seen a bit of it--anyhow, you've got to face it--

"Our world has changed in these thirty years, more than the change between what it used to be and what people used to imagine about Heaven. Here is the first thing you've got to do--mentally. You must understand, clearly, in your human consciousness, that the objection and distaste you feel is only in your personal consciousness. Everything is better; there is far more comfort, pleasure, peace of mind; a richer, swifter growth, a higher happier life in every way; and yet, you won't like it because your--" she seemed to hesitate for a word, now and then; as one trying to translate, "reactions are all tuned to earlier conditions. If you can understand this and see over your own personal--attitudes it will not be long before a real convincing _sense_ of joy, of life, will follow the intellectual perception that things are better."

"Hold on," I said, "Let me chew on that a little."

"As if," I presently suggested, "as if I'd left a home that was poor and dirty and crowded, with a pair of quarrelsome inefficient parents--drunken and abusive, maybe, and a lot of horrid, wrangling, selfish, little brothers and sisters--and woke up one fine morning in a great clean beautiful house--richly furnished--full of a lot of angels--who were total strangers?"

"Exactly!" she cried. "Hurrah for you, Johnnie, you couldn't have defined it better."

"I don't like it," said I. "I'd rather have my old home and my own family than all the princely palaces and amiable angels you could dream of in a hundred years."

"Mother had an old story-book by a New England author," Nellie quietly remarked, "where somebody said, 'You can't always have your druthers'--she used to quote it to me when I was little and complained that things were not as I wanted them. John, dear, please remember that the new people in the new world find it 'like home' and love it far better than we used to. It'll be queer to you, but it's a pleasant commonplace to them. We have found out at last that it is natural to be happy."

She was silent and I was silent; till I asked her "What's the name of your new religion?"

"It hasn't any," she answered.

"Hasn't any? What do they call it? the Believers, I mean?"

"They call it 'Living' and 'Life'--that's all."

"Hm! and what's their specialty?"

Nellie gave a funny little laugh, part sad, part tender, part amused.

"I had no idea it would be so hard to tell you things," she said. "You'll have to just see for yourself, I guess."

"Do go on, Nellie. I'll be good. You were going to tell me, in a nutshell, what had happened--please do."

"The thing that has happened," said she, slowly, "is just this. The world has come alive. We are doing in a pleasant, practical way, all the things which we could have done, at any time before--only we never thought so. The real change is this: we have changed our minds. This happened very soon after you left. Ah! that was a time! To think that you should have missed it!" She gave my hand another sympathetic squeeze and went on. "After that it was only a question of time, of how soon we could do things. And we've been doing them ever since, faster and faster."

This seemed rather flat and disappointing.

"I don't see that you make out anything wonderful--so far. A new Religion which seems to consist only in behaving better; and a gradual improvement of social conditions--all that was going on when I left."

Nellie regarded me with a considering eye. "I see how you interpret it," she said, "behaving better in our early days was a small personal affair; either a pathetically inadequate failure to do what one could not, or a Pharisaic, self-righteous success in doing what one could. All personal--personal!"

"Good behavior has to be a personal affair, hasn't it?" I mildly protested.

"Not by any means!" said Nellie with decision. "That was precisely what kept us so small and bad, so miserably confined and discouraged. Like a lot of well-meaning soldiers imagining that their evolutions were 'a personal affair'--or an orchestra plaintively protesting that if each man played a correct tune of his own choosing, the result would be perfect! Dear! dear! No, _Sir_, " she continued with some fierceness, "that's just where we changed our minds! Humanity has come alive, I tell you and we have reason to be proud of our race!"

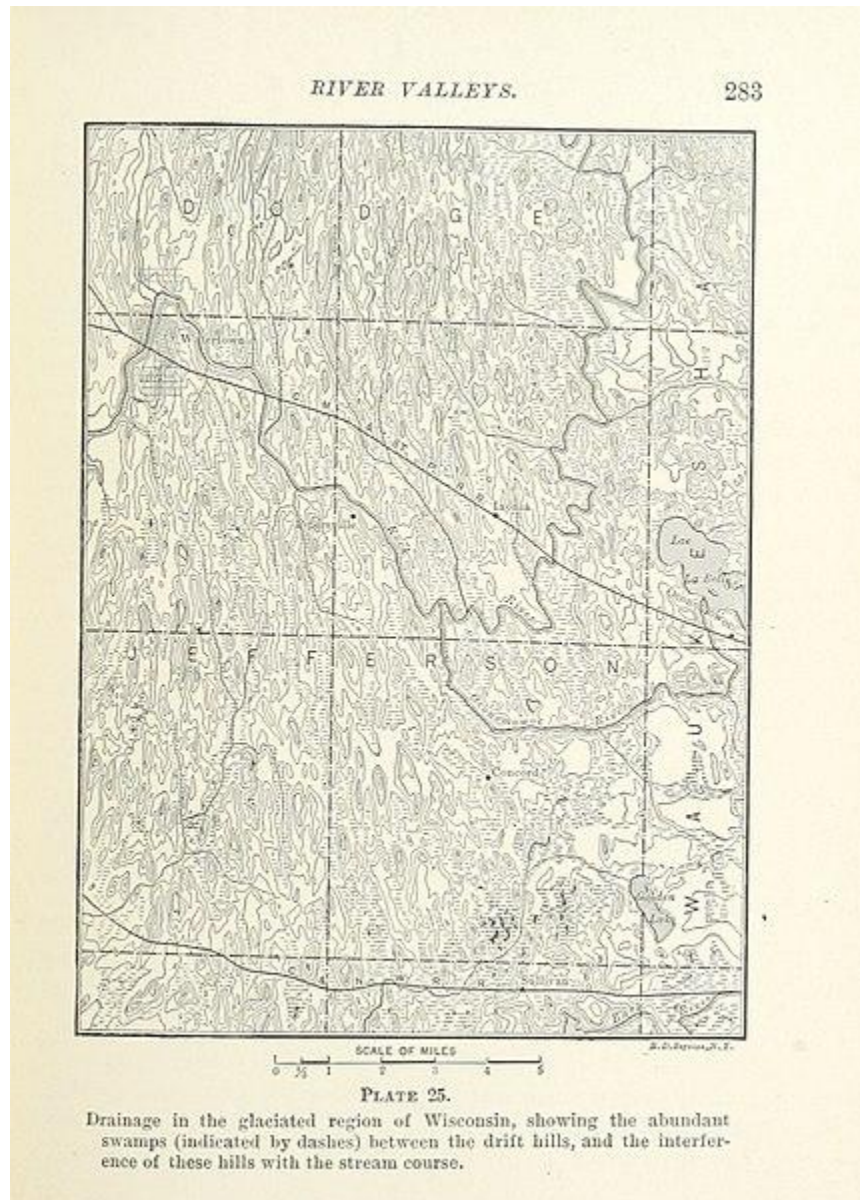
She held her head high, there was a glad triumphant look in her eyes--not in the least religious. Said she:

"You'll see results. That will make it clearer to you than anything I can say. But if I may remark that we have no longer the fear of death--much less of damnation, and no such thing as 'sin'; that the only kind of prison left is called a quarantine--that punishment is unknown but preventive means are of a drastic and sweeping nature such as we never dared think of before--that there is no such thing in the civilized world as poverty--no labor problem--no color problem--no sex problem--almost no disease--very little accident--practically no fires--that the world is rapidly being reforested--the soil improved; the output growing in quantity and quality; that no one needs to work over two hours a day and most people work four--that we have no graft--no adulteration of goods--no malpractice--no crime."

"Nellie," said I, "you are a woman and my sister. I'm very sorry, but I don't believe it."

"I thought you wouldn't," said she. Women always will have the last word.

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CHAPTER II.

The Project Gutenberg EBook [#61652]
of *Physical Geography*, by Mary Somerville
1850

Direction of the Forces that raised the Continents—Proportion of Land and Water—Size of the Continents and Islands—Outline of the Land—Extent of Coasts, and proportion they bear to the Areas of the Continents—Elevation of the Continents—Forms of Mountains—Forms of Rocks—Connection between Physical Geography of Countries and their Geological Structure—Contemporaneous Upheaval of parallel Mountain Chains—Parallelism of Mineral Veins or Fissures—Mr. Hopkins's Theory of Fissures—Parallel Chains similar in Structure—Interruptions in Continents and Mountain Chains—Form of the Great Continent—The High Lands of the Great Continent—The Atlas, Spanish, French, and German Mountains—The Alps, Balkan, and Apennines—Glaciers—Geological Notice.

AT the end of the tertiary period the earth was much in the same state as it is at present with regard to the distribution of land and water. The preponderance of land in the northern hemisphere indicates a prodigious accumulation of internal energy under these latitudes at a very remote geological period. The forces that raised the two great continents above the deep, when viewed on a wide scale, must evidently have acted at right angles to one another, nearly parallel to the equator in the old continent, and in the direction of the meridian in the new; yet the structure of the opposite coasts of the Atlantic points at some connection between the two.

The mountains, from their rude and shattered condition, bear testimony to repeated violent convulsions similar to modern earthquakes; while the high table-lands, and that succession of terraces by which the continents sink down from their mountain-ranges to the plains, to the ocean, and even below it, show also that the land must have been heaved up occasionally by slow and gentle pressure, such as appears now to be gradually elevating the coast of Scandinavia and many other parts of the earth. The periods in which these majestic operations were effected must have been incalculable, since the dry land occupies an area of nearly 38,000,000 of square miles.

The ocean covers nearly three-fourths of the surface of the globe, but the distribution is very unequal, whether it be considered with regard to the northern and southern hemispheres, or the eastern and western. Independently of Victoria Land, whose extent is unknown, the quantity of land in the northern hemisphere is three times greater than in the southern. In the latter it occupies only one-sixteenth of the space between the Antarctic Circle and the thirtieth parallel of south latitude, while between the corresponding parallels in the northern hemisphere the extent of land and water is nearly equal. If the globe be

divided into two hemispheres by a meridian passing through the island of Teneriffe, the land will be found to predominate greatly on the eastern side of that line, and the water on the western. In consequence of the very unequal arrangement of the solid and liquid portions of the surface of the earth, England is nearly in the centre of the greatest mass of land, and its antipode, the island of New Zealand, is in the centre of the greatest mass of water; so that a person raised above Falmouth, which is almost the central point, till he could perceive a complete hemisphere, would see the greatest possible expanse of land, while, were he elevated to the same height above New Zealand, he would see the greatest possible extent of ocean. In fact, only one twenty-seventh of the land has land directly opposite to it in the opposite hemisphere, and under the equator five-sixths of the circumference of the globe is water. It must, however, be observed that there is still an unexplored region within the Antarctic Circle more than twice the size of Europe, and of the north polar basin we know nothing. With regard to the land alone, the great continent has an area of about 24,000,000 square miles, while the extent of America is 11,000,000, and that of Australia with its islands scarcely 3,000,000. Africa is more than three times the size of Europe, and Asia is more than four times as large. The extent of the continents is twenty-three times greater than that of all the islands taken together.[15]

Of the polar lands little is known. Greenland probably is part of a continent, the domain of perpetual snow; and the recent discovery of so extensive a mass of high volcanic land near the south pole is an important event in the history of physical science, though the stern severity of the climate must for ever render it unfit for the abode of animated beings, or even for the support of vegetable life. It seems to form a counterpoise to the preponderance of dry land in the northern hemisphere. There is something sublime in the contemplation of these lofty and unapproachable regions—the awful realm of ever-during ice and perpetual fire, whose year consists of one day and one night. The strange and terrible symmetry in the nature of the lands within the polar circles, whose limits are to us a blank, where the antagonist principles of cold and heat meet in their utmost intensity, fills the mind with that awe which arises from the idea of the unknown and the indefinite.

The tendency of the land to assume a peninsular form is very remarkable, and it is still more so that almost all the peninsulas tend to the south—circumstances that depend on some unknown cause which seems to have acted very extensively. The continents of South America, Africa, and Greenland, are peninsulas on a gigantic scale, all tending to the

south; the Asiatic peninsula of India, the Indo-Chinese peninsula, those of Corea, Kamtchatka, of Florida, California, and Aliaska, in North America, as well as the European peninsulas of Norway and Sweden, Spain and Portugal, Italy and Greece, take the same direction. All the latter have a rounded form except Italy, whereas most of the others terminate sharply, especially the continents of South America and Africa, India, and Greenland, which have the pointed form of wedges; while some are long and narrow, as California, Aliaska, and Malacca. Many of the peninsulas have an island or group of islands at their extremity, as South America, which terminates with the group of Tierra del Fuego: India has Ceylon; Malacca has Sumatra and Banca; the southern extremity of New Holland ends in Van Dieman's Land; a chain of islands run from the end of the peninsula of Aliaska; Greenland has a group of islands at its extremity; and Sicily lies close to the termination of Italy. It has been observed as another peculiarity in the structure of peninsulas that they generally terminate boldly, in bluffs, promontories, or mountains, which are often the last portions of the continental chains. South America terminates in Cape Horn, a high promontory, which is the visible termination of the Andes; Africa with the Cape of Good Hope; India with Cape Comorin, the last of the Ghauts; New Holland ends with South-East Cape in Van Dieman's Land; and Greenland's farthest point is the elevated bluff of Cape Farewell.[16]

There is a strong analogy between South America and Africa in form and the unbroken mass which their surface presents, while North America resembles Europe, in being much indented by inland seas, gulfs, and bays. Eastern Asia is evidently continued in a subaqueous continent from the Indian Ocean across the Pacific nearly to the west coast of America, of which New Holland, the Indian Archipelago, the islands of the Asiatic coast and of Oceania, are the great table-lands and summits of its mountain-chains. With the exception of a vast peninsula in Siberia, between the mouths of the rivers Yenesei and Khatanga and the unknown regions of Greenland, the two great continents terminate in a very broken line to the north; and as they sink beneath the Icy Ocean, the tops of their high lands and mountains rise above the waves and stud the coast with innumerable snow-clad rocks and islands. The 70th parallel is the average latitude of these northern shores, which have a great similarity on each side of Behring's Straits in form, direction, and in the adjacent islands.

The peninsular form of the continents adds greatly to the extent of their coasts, of such importance to civilization and commerce. All the shores of Europe are deeply indented and penetrated by the Atlantic Ocean, which has formed a number of inland seas of great magnitude, so

that it has a greater line of maritime coast, compared with its size, than any other quarter of the world. The extent of coast from the Straits of Waigatz, in the Polar Ocean, to the Strait of Caffa, at the entrance of the Sea of Azoff, is about 17,000 miles. The coast of Asia has been much worn by currents, and possibly also by the action of the ocean occasioned by the rotation of the earth from west to east. On the south and east especially it is indented by large seas, bays, and gulfs; and the eastern shores are rugged and encompassed by chains of islands which render navigation dangerous. Its maritime coast is about 33,000 miles in length.

The coast of Africa, 16,000 miles long, is very entire, except perhaps at the Gulf of Guinea and in the Mediterranean. The shores of North America have probably been much altered by the equatorial current and the Gulf-stream. There is little doubt that these currents, combined with volcanic action, have hollowed out the Gulf of Mexico, and separated the Antilles and Bahama Islands from the continent. The coast is less broken on the west, but in the icy Ocean there is a labyrinth of gulfs, bays, and creeks. The shores of South America on both sides are very entire, except towards Southern Chile and Cape Horn, where the tremendous surge and currents of the ocean in those high latitudes have eaten into the mountains, and produced endless sounds and fiords which run far into the land. The whole continent of America has a sea-coast of 31,000 miles. Thus, it appears that the ratio of the number of linear miles in the coast-line to the number of square miles in the extent of surface, in each of these great portions of the globe, is 164 for Europe, 376 for Asia, 530 for Africa, and 359 for America. Hence, the proportion is most favourable to Europe, with regard to civilization and commerce; America comes next, then Asia, and last of all Africa, which has every natural obstacle to contend with, from the extent and nature of its coasts, the desert character of the country, and the insalubrity of its climate, on the Atlantic coast at least.

The continents had been raised from the deep by a powerful effort of the internal forces acting under widely-extended regions, and the stratified crust of the earth either remained level, rose in undulations, or sank into cavities, according to its intensity. Some thinner portion of the earth's surface, giving way to the internal forces, had been rent into deep fissures, and the mountain masses had been raised by violent concussions, perceptible in the convulsed state of their strata. The centres of maximum energy are marked by the pyrogenous rocks, which generally form the nucleus or axis of the mountain masses, on whose flanks the stratified rocks are tilted at all angles to the horizon, whence, declining on every side, they sink to various depths, or stretch

to various distances in the plains. Enormous as the mountain-chains and table-lands are, and prodigious as the forces that elevated them, they bear a very small proportion to the mass of the level continents and to the vast power which raised them even to their inferior altitude. Both the high and the low lands had been elevated at successive periods; some of the very highest mountain-chains are but of recent geological date, and some chains that are now far inland once stood up as islands above the ocean, while marine strata filled their cavities and formed round their bases. The influence of mountain-chains on the extent and form of the continents is beyond a doubt.

Notwithstanding the various circumstances of their elevation, there is everywhere a certain regularity of form in mountain masses, however unsymmetrical they may appear at first, and rocks of the same kind have identical characters in every quarter of the globe. Plants and animals vary with climate, but a granite mountain has the same peculiarities in the southern as in the northern hemisphere—at the equator as near the poles. Single mountains, insulated on plains, are rare, except where they are volcanic; they generally appear in groups intersected by valleys in every direction, and more frequently in extensive chains symmetrically arranged in a series of parallel ridges, separated by narrow longitudinal valleys, the highest and most rugged of which occupy the centre: when the chain is broad and of the first order in point of magnitude, peak after peak arises in endless succession. The lateral ridges and valleys are constantly of less elevation, and are less bold, in proportion to their distance from the central mass, till at last the most remote ridges sink down into gentle undulations. Extensive and lofty branches diverge from the principal chains at various angles, and stretch far into the plains. They are often as high as the chains from which they spring, and it happens not unfrequently that these branches are united by transverse ridges, so that the country is often widely-covered by a net-work of mountains, and, at the point where these offsets diverge, there is frequently a knot of mountains spreading over hundreds of square miles.

One side of a mountain range is usually more precipitous than the other, but there is nothing in which the imagination misleads the judgment more than in estimating the steepness of a declivity. In the whole range of the Alps there is not a single rock which has 1600 feet of perpendicular height, or a vertical slope of 90° . The declivity of Mont Blanc towards the Allée Blanche, precipitous as it seems, does not amount to 45° ; and the mean inclination of the peak of Teneriffe, according to Baron Humboldt, is only $12^{\circ} 30'$. The Silla of Caraccas, which rises precipitously from the Caribbean Sea, at an angle of $53^{\circ} 28'$, to the

height of between 6000 and 7000 feet, is a majestic instance of perhaps the nearest approach to perpendicularity of any great height yet known.

The circumstances of elevation are not the only causes of that variety observed in the summits of mountains. A difference in the composition and internal structure of a rock has a great influence upon its general form, and on the degree and manner in which it is worn by the weather. Thus dolomite assumes generally the form of peaks like saw-teeth; crystalline schists assume the form of needles, as in the Alps; slates and quartziferous schists take the form of triangular pyramids; calcareous rocks a rounded shape; serpentine and trachyte are often twisted and crumpled; phonolites assume a pyramidal form; dark walls like those in Greenland are of trap and basalt; and volcanoes are indicated by blunt cones and craters. Thus, the mountain-peaks often indicate by their form their geological nature.

Viewing things on a broad scale, it appears that there is also a very striking connection between the physical geography or external aspect of different countries and their geological structure. By a minute comparison of the different parts of the land, M. Boué has shown that a critical similarity of outward forms, while indicating similarity in the producing causes, must also, to a large extent, indicate identity of structure, and therefore from the external appearance of an unexplored country its geological structure may be inferred, at least to a certain extent. This he illustrates by pointing out a correspondence, even in their most minute details, between the leading features of Asia and Europe, and the identity of their geological structure. It has been justly observed, that when the windings of our continents and seas are narrowly examined, and the more essential peculiarities of their contours contemplated, it is evident that Nature has not wrought after an indefinite number of types or models, but that, on the contrary, her fundamental types are very few, and derived from the action of definite constructive forces on a primary base.[17] The whole of our land and sea, in fact, may be decomposed into a less or greater number of masses, either exhibiting all these fundamental forms or merely a portion of them.[18] The peninsular structure of the continents with their accompanying islands is a striking illustration of the truth of this remark, and many more might be adduced. It follows, as a consequence of that law in Nature's operations, that analogy of form and contour throws the greatest light on the constitution of countries far removed from each other. Even the picturesque descriptions of a traveller often afford information of which he may be little aware.

The determination of the contemporaneous upheaval of parallel

mountain-chains, by a comparison of the ages of the inclined and horizontal strata resting on them, is one of the highest steps of generalization which has been attempted by geologists. It was first observed by the miners of the Freyberg school, and established as a law by Werner, that veins of the same nature in mines occur in parallel fissures opened at the same time, and probably filled with metal, also simultaneously, at a subsequent period; and that fissures differing in direction differ also in age. As these veins and fissures are rents through the solid strata, often of unfathomable depth and immense length, there is the strongest analogy between them and those enormous fissures in the solid mass of the globe through which the mountain-chains have been heaved up. Were the analogy perfect, it ought to follow that parallel mountain-chains have been raised simultaneously, that is, by forces acting during the same geological periods. By a careful examination of the relative ages of the strata resting on the flanks of many of the mountain systems, M. Elie de Beaumont has shown, if not proved, that all strata elevated simultaneously assume a parallel direction, or, that parallel strata are contemporaneous. Should this be confirmed, parallel chains in the most distant regions will no longer be regarded as insulated masses. They will indicate the course of enormous fissures that have simultaneously rent the solid globe and passed through the bed of the ocean from continent to continent, from island to island. M. Von Buch has found that four systems of mountains in Germany accord with this theory, and Mr. Sedgwick has observed the same in the Westmoreland system of mountains, believed to be the most ancient of which the globe can now furnish any traces. This theory of elevation of mountain-chains, which originated with M. Elie de Beaumont, has already led to the discovery of twelve different periods of fracture and elevation in the European continent alone.

Mr. Hopkins, of Cambridge, has taken a purely mathematical view of the subject, and has proved that, when an internal expansive force acts upwards upon a single point in the earth's crust, the splits or cracks must all diverge from that point like radii in a circle, which is exactly the case in many volcanic districts; that when the expansive force acts uniformly from below on a wide surface or area, it tends to stretch the surface, so that it would split or crack where the tension is greatest, that is, either in the direction of the length or breadth; and if the area yields in more places than one, he found that the fissures would necessarily be parallel to one another, which agrees with the law of arrangement of veins in mines. These results are greatly modified by the shape of the area, but the modification is according to a fixed law, which, instead of interfering with that of the parallelism of the fissures, actually arises from the same action which produces it.

This investigation agrees in all its details with the fractures in the districts in England to which they were applied, so that theory comes to the aid of observation in this still unsettled question.[19]

It seems to bear on the subject, that parallel mountain-chains are similar in geological age, even when separated by seas. For instance, the mountains of Sweden and Finland are of the same structure, though the Gulf of Bothnia is between them; those of Cornwall, Brittany, and the north-west of Spain are similar; the Atlas and the Spanish mountains, the chains in California and those on the adjacent coast of America, and, lastly, those of New Guinea and the north-east of Australia, furnish examples. The same correspondence in geological epoch prevails in chains that are not parallel, but that are convergent from the form of the earth. This observation is also extensively exemplified in those that run east and west, as the Alps, the Balkan, Taurus, Paropamisus with its prolongation, the Hindoo Coosh, the Himalaya, and in America the mountains of Parima and the great chain of Venezuela.

Continents and mountain-chains are often interrupted by posterior geological changes, such as clefts and cavities formed by erosion, as evidently appears from the correspondence of the strata. The chalk cliffs on the opposite sides of the British Channel show that Britain once formed part of the continent; the formation of the Orkney Islands and Ireland is the same with that of the Highlands of Scotland; the formation is the same on each side of the Straits of Gibraltar; that of Turkey in Europe passes into Asia Minor, the Crimea into the Caucasus, a volcanic region bounds the Straits of Babelmandel, and Behring's Straits divide the ancient strata of a similar age. This is particularly the case with coast islands.[20]

Immediately connected with the mountains are the high table-lands which form so conspicuous a feature in the Asiatic and American continents. These perpetual storehouses of the waters send their streams to refresh the plains, and to afford a highway between the nations. Table-lands of less elevation, sinking in terraces of lower and lower level, constitute the links between the high ground and the low, the mountains and the plains, and thus maintain the continuity of the land. They frequently are of the richest soil, and enjoy the most genial climate, affording a delightful and picturesque abode to man, though the plains are his principal dwelling. Sloping imperceptibly from the base of the inferior table-lands, or from the last undulations of the mountains, to the ocean, they carry off the superfluous waters. Fruitfulness and sterility vary their aspect: immense tracts of the richest soil are favoured by climate, and hardly require culture; a greater portion is only rendered

productive by hard labour, compelling man to fulfil his destiny; while vast regions are doomed to perpetual barrenness, never gladdened by a shower.

The form of the great continent has been determined by an immense zone of mountains and table-lands, lying between the 30th and 40th or 45th parallels of north latitude, which stretches across it from W.S.W. to E.N.E., from the coasts of Barbary and Portugal, on the Atlantic Ocean, to the farthest extremity of Asia, at Behring's Straits, in the North Pacific. North of this lies a vast plain, extending almost from the Pyrenees to the utmost parts of Asia, the greater portion of which is a dead level, or low undulations, uninterrupted except by the Scandinavian and British system on the north, and the Ural chain, which is of small elevation. The low lands south of the mountainous zone are much indented by the ocean, and of the most diversified aspect. By much the greater part of the flat country lying between the China Sea and the river Indus is of the most exuberant fertility, while that between the Persian Gulf and the foot of the Atlas is, with some happy exceptions, one of the most desolate tracts on the earth. The southern lowlands, too, are broken by a few mountain systems of considerable extent and height.

The Atlas and Spanish mountains form the western extremity of that great zone of high lands that girds the old continent almost throughout its extent: these two mountain systems were certainly at one time united, and from their geological formation, and also the parallelism of their mountain-chains, they must have been elevated by forces acting in the same direction; now, indeed, the Strait of Gibraltar, a sea-filled chasm 960 fathoms deep, divides them.[21]

A very elevated and continuous mountain region extends in a broad belt along the north-west of Africa, from the promontory of Gher, on the Atlantic, to the Gulf of Sidra, in the Mediterranean, enclosing all the high lands of Morocco, Algiers, and Tunis. It is bounded by the Atlantic and Mediterranean, and insulated from the rest of Africa by the desert of Sahara.

This mountain system consists of three parts. The chain of the Greater Atlas, which is farthest inland, extends from Cape Gher, on the Atlantic, to the Lesser Syrtis; and, in Morocco, forms a knot of mountains 15,000 feet high, covered with perpetual snow.

The Lesser Atlas begins at Cape Spartel (the ancient Cape Cotes) opposite to Gibraltar, and keeps parallel to the Mediterranean till it attains the Gharian range in Tripoli, the last and lowest of the Little

Atlas, which runs due east in a uniformly diminishing line till it vanishes in the plain of the Great Syrtis. That long, rugged, but lower chain of parallel ridges and groups which forms the bold coasts of the Straits of Gibraltar and the Mediterranean, is only a portion of the Lesser Atlas, which rises above it majestically, covered with snow. The flanks of the mountains are generally clothed with forests, but their summit is one uninterrupted line of bare inaccessible rocks, and they are rent by fissures frequently not more than a few feet wide—a peculiar feature of the whole system.

The Middle Atlas, lying between the two great chains, consists of a table-land, rich in valleys and rivers, which rises in successive terraces to the foot of the Greater Atlas, separated by ridges of hills parallel to it. This wide and extensive region has a delightful climate, abounds in magnificent forests, and the valleys are full of vitality. The crest of the Atlas is of granite and crystalline strata; their flanks and lower ranges are sandstone and limestone, on which the tertiary strata rest.

The Spanish peninsula consists chiefly of a table-land traversed by parallel ranges of mountains, and is surrounded by the sea, except where it is separated from France by the Pyrenees, which extend from the Mediterranean to the Bay of Biscay, but are continued by the Cantabrian chain to Cape Finisterre on the Atlantic.

The Pyrenean chain is of moderate height at its extremities, but its summit maintains a waving line, whose mean altitude is 7990 feet; it rises to a greater height on the east; its highest point is the Malahite or Nethou, 11,170 feet above the sea. The snow lies deep on these mountains during the greater part of the year, and is perpetual on the highest parts; but the glaciers, which are chiefly on the northern side, are neither so numerous nor so large as in the Alps.

The greatest breadth of this range is about 60 miles, and its length 270. It is so steep on the French side, so rugged and so notched, that from the plains below its summits look like the teeth of a saw, whence the term Sierra has been appropriated to mountains of this form. On the Spanish side, gigantic sloping offsets, separated by deep precipitous valleys, extend to the banks of the Ebro. All the Spanish mountains are torn by deep crevices, the beds of torrents and rivers.

The interior of Spain is a table-land with an area of 93,000 square miles, nearly equal to half of the peninsula. It dips to the Atlantic from its western side, where its altitude is about 2300 feet. There it

is bounded by the Iberian mountains, which begin at the point where the Pyrenees take the name of the Cantabrian chain, and run in a tortuous south-easterly direction through all Spain, constituting the eastern boundary of Valencia and Murcia, and sending many branches through those provinces to the Mediterranean: its most elevated point is the Sierra Urbion.

Four nearly parallel ranges of mountains originate in this limiting chain, running from E.N.E. to W.S.W. diagonally across the peninsula to the Atlantic. Of these, the high Castilian chain of the Guadarama and the Sierra de Toledo cross the table-land, the Sierra Morena, so called from the dingy colour of its forests of Hermes oak, on the southern edge; and lastly, the Sierra Nevada, though only 100 miles long and 50 broad, the finest range of mountains in Europe after the Alps, traverses the plains of Andalusia and Grenada. The table-land is monotonous and bare of trees; the plains of Old Castile are as naked as the Steppes of Siberia, and uncultivated, except along the banks of the rivers. Corn and wine are produced in abundance on the wide plains of New Castile and Estremadura: other places serve for pasture. The table-land becomes more fertile as it extends towards Portugal, which is altogether more productive than Spain, though the maritime provinces of the latter on the Mediterranean are luxuriant and beautiful, with a semi-tropical vegetation.

Granite, crystalline strata, and primary fossiliferous rocks prevail chiefly in the Spanish mountains, and give them their peculiar, bold, serrated aspect. The valleys between the parallel ranges, through which the great Spanish rivers flow to the Atlantic, appear to have been at one time the basins of lakes.

The mass of high land is continued through the south of France, at a much lower elevation, by chains of hills and table-lands, the most remarkable of which are the Montagnes Noires, and the great plateau of Auvergne, once the theatre of violent volcanic action. It continued from the beginning to the middle of the tertiary period, so that there are cones and craters of various ages and perfect form: some of the highest, as the Puy de Dôme, are trachytic domes of elevation; Mont d'Or, 6200 feet high, is a portion of an immense crater of elevation.[22] The volcanic mountains of Auvergne, and the Cévennes, which are a little lower, are the most remarkable of the French system; the offsets of the latter reach the right bank of the Rhone. In fact, the French mountains are the link between the more elevated masses of Western and Eastern Europe.

The eastern and highest part of the European portion of the mountain-zone begins to rise above the low-lands about the 52d parallel of north latitude, ascending by terraces, groups, and chains of mountains, through six or seven degrees of latitude, till it reaches its highest point in the great range of the Alps and Balkan. The descent on the south side of this lofty mass is much more rapid and abrupt, and the immediate offsets from the Alps shorter; but, taking a very general view, the Apennines and mountains of Northern Sicily, those of Greece and the southern part of Turkey in Europe, with all the islands of the adjacent coasts, are but outlying members of the general protuberance.

The principal chain of the Hyrcanian mountains, the Sudetes, and the Carpathian mountains, form the northern boundary of these high lands: the first, consisting of three parallel ridges, extends from the right bank of the Rhine to the centre of Germany, about 51° or 52° of N. lat., with a mean breadth of about 100 miles, and terminates in the knot of the Fichtelberge, covering an area of 9000 square miles, on the confines of Bavaria and Bohemia. The Sudetes begin on the east of this group, and, after a circuit of 300 miles round Bohemia, terminate at the small elevated plain of the Upper Oder, which connects them with the Carpathian mountains. No part of these limiting ranges attains the height of 5000 feet, except the Carpathians, some of which are very high. They consist of mountain-groups united by elevated plains, rather than of a single chain: the Tatra mountains, bisected by the 20th meridian, is their loftiest point. This range is high also in Transylvania, before it reaches the Danube, which divides it from a secondary branch of the Balkan. Spurs decline in undulations from these limiting chains on the great northern plain, and the country to the south, intervening between them and the Alps, is covered with an intricate network of mountains and plains of moderate elevation.

The higher Alps, which form the western crest of the elevated zone, may be said to begin at the Cape della Melle on the Gulf of Genoa, and bend round by the west and north to Mont Blanc; then turning E.N.E. they run through the Grisons and Tyrol to the Great Glockner, in $40^{\circ} 7'$ N. lat., and $12^{\circ} 43'$ E. long., where the higher Alps terminate a course 420 miles long. All this chain is lofty; much of it is above the line of perpetual congelation; the most elevated part lies between the Col de la Seigne, on the western shoulder of Mont Blanc, and the Simplon. The highest mountains in Europe are comprised within this space, not more than 60 miles long, where Mont Blanc, the highest of all, has an absolute elevation of 15,759·8 feet. The central ridge of the higher Alps is jagged with peaks, pyramids, and needles of bare and almost perpendicular rock, rising from fields of perpetual snow and rivers of

ice to an elevation of 14,000 feet. Many parallel chains and groups, alike rugged and snowy, press on the principal crest, and send their flanks far into the lower grounds. Innumerable secondary branches, hardly lower than the main crest, diverge from it in various directions; of these, the chain of the Bernese Alps is the highest and most extensive. It breaks off at the St. Gothard, in a line parallel to the principal chain, separates the Valais from the Canton of Berne, and with its ramifications forms one of the most remarkable groups of mountain scenery in Europe. Its endless maze of sharp ridges and bare peaks, mixed with gigantic masses of pure snow, fading coldly serene into the blue horizon, present a scene of sublime quiet and repose, unbroken but by the avalanche or the thunder.

At the Great Glockner the range of the Alps, hitherto undivided, splits into two branches, the Noric and Carnic Alps: the latter is the continuation of the chief stem. Never rising to the height of perpetual snow, it separates the Tyrol and Upper Carinthia from the Venetian States, and, taking the name of the Julian Alps at Mont Terglou, runs east till it joins the Eastern Alps, or Balkan, under the 18th meridian. Offsets from this chain cover all the neighbouring countries.

It is difficult to estimate the width of the Alpine chain: that of the higher Alps is about 100 miles; it increases to 150 east of the Grisons, and amounts to 200 between the 15th and 16th meridians, but is not more than 80 at its junction with the Balkan.

The Stelvio, 9174 feet above the sea, is the highest carriage-pass in these mountains. That of St. Gothard goes directly over the crest of the Alps. Passes very rarely go over the summit of a mountain; they generally cross the watershed, ascending by the valley of a torrent, and descending by a similar path on the other side.

The frequent occurrence of extensive deep lakes is a peculiar feature in European mountains, rarely to be met with in the Asiatic system, except in the Altaï and on the elevated plains.

With the exception of the Jura, whose pastoral summit is about 3000 feet above the sea, there are no elevated table-lands in the Alps: the tabular form, so eminently characteristic of the Asiatic high lands, begins in the Balkan. The Oriental peninsula rises by degrees from the Danube to Bosnia and Upper Macedonia, which are some hundred feet above the sea; and the Balkan extends 600 miles along this elevated mass, from the Julian Alps to Cape Eminac on the Black Sea. It begins by a table-land 70 miles long, traversed by low hills, ending, towards

Albania and Myritida, in precipitous limestone rocks from 6000 to 7000 feet high. Rugged mountains, all but impassable, succeed to this, in which the domes and needles of the Schandach, or ancient Scamus, are covered with perpetual snow. Another table-land follows, whose marshy surface is bounded by mural precipices at Mount Arbelus, near the town of Sophia. There the Hemus, or Balkan properly so called, begins, and runs in parallel ridges, separated by longitudinal valleys, to the Black Sea, dividing the plains between the Lower Danube and the Propontis into nearly equal parts. The central ridge is passable in few places, and where there is no lateral ridge the precipices descend at once to the plains.

The Balkan is everywhere rent by terrific fissures across the chains and table-lands, so deep and narrow that daylight is almost excluded. These chasms afford the safest passes across the range; the others along the faces of the precipices are frightful.

The Mediterranean is the southern boundary of the elevated zone of Eastern Europe, whose last offsets rise in rocky islands along the coasts. The crystalline mountains of Sardinia and Corsica are outlying members of the Maritime Alps, while shorter offsets end in the plains of Lombardy, forming the magnificent scenery of the Italian lakes. Even the Apennines, whose elevation has given its form to the peninsula of Italy, are but secondary on a greater scale to the broad central band, as well as the mountains and high land in the north of Sicily, which form the continuance of the Calabrian chain.

The Apennines, beginning at the Maritime Alps, enclose the Gulf of Genoa, and run through the centre of Italy in parallel ranges to the middle of Calabria, where they split into two branches, one of which goes to Capo de Leuca, on the Gulf of Torento, the other to Cape Spartivento, in the Straits of Messina. The whole length is about 800 miles. None of the Apennines come within the line of perpetual snow, though it lies nine months in the year on the Gran Sasso d'Italia, 9521 feet high, in Abruzzza Ulteriore.

Offsets from the Julian and Eastern Alps render Dalmatia and Albania perhaps the most rugged tract in Europe; and the Pindus, which forms the watershed of Greece, diverges from the latter chain, and, running south 200 miles, separates Albania from Macedonia and Thessaly.

Greece is a country of mountains, and, although none are perpetually covered with snow, it lies nine months on several of their summits. The chains terminate in strongly projecting headlands, which reach far into

the sea, and reappear in the numerous islands and rocks which stud that deeply-indented coast. The Grecian mountains, like the Balkan, are torn by transverse fractures. The defile of Blatamana and the Gulf of Salonica are examples. The Adriatic, the Dardanelles, and the Sea of Marmora limit the secondaries of the southern part of the Balkan.

The valleys of the Alps are long and narrow; those among the mountains of Turkey in Europe and Greece are mostly caldron-shaped hollows, often enclosed by mural rocks. Many of these cavities of great size lie along the foot of the Balkan. In the Morea they are so encompassed by mountains that the water has no escape but through the porous soil. They consist of tertiary strata, which had formed the bottom of lakes. Caldron-shaped valleys occur also in most volcanic countries, as Sicily, Italy, and central France.

The table-lands which constitute the tops of mountains or of mountain-chains are of a different character from those terraces by which the high lands slope to the low. The former are on a small scale in Europe, and of a forbidding aspect, with the exception of the Jura, which is pastoral, whereas the latter are almost always habitable and cultivated. The mass of high land in south-eastern Europe shelves on the north to the great plain of Bavaria, 3000 feet high; Bohemia, which slopes from 1500 to 900 feet; and Hungary, from 4000 above the sea to 300. The descent on the south of the Alps is six or seven times more rapid, because the distance from the axis of the chain is shorter.

It is scarcely possible to estimate the quantity of ice on the Alps; it is said, however, that, independent of the glaciers in the Grisons, there are 1500 square miles of ice in the Alpine range, from 80 to 600 feet thick. There are no glaciers east of the Great Glockner, except on the small group of Hallstadt. Thirty-four bound the snowy regions of Mont Blanc, and 95 square miles of snow and ice clothe that mountain. Some glaciers have been permanent and stationary in the Alps time immemorial, while others now occupy ground formerly bearing corn or covered with trees, which the irresistible force of the ice has swept away. These ice-rivers, formed on the snow-clad summits of the mountains, fill the hollows and high valleys, hang on the declivities, or descend by their weight through the transverse valleys to the plains, where they are cut short by the increased temperature, and deposit those accumulations of rocks and rubbish, called moraines, which had fallen upon them from the heights above; but their motion is so slow, that six generations may pass before a stone fallen on the upper end of a long glacier can reach the moraine. In the Alps, the glaciers move at the rate of from 12 to 25 feet annually, and, as in rivers, the motion is

most rapid in the centre, and slower at the sides and bottom on account of friction. It is slower in winter, yet it does not cease, because the winter's cold penetrates the ice, as it does the ground, only to a limited depth. Glaciers are not of solid ice; they consist of a mixture of ice, snow, and water; so that they are in some degree flexible and viscous, but acquire more solidity as they descend to lower levels; evaporation goes on at their surface, but they are not consumed by it. The front is perpetually melting, but maintains a permanent form; it is steep and inaccessible, owing to the figure of the ground over which it tumbles in its icy cascade, sometimes 1000 feet high. The middle course is rather level, the higher part very steep, and the surface is uneven and rent by crevices into which the purest blue streams fall in rushing cascades while the sun is up, but they freeze at his setting, and then a death-like silence prevails. The rocks and stones that fall on them from the surrounding heights protect the ice below from the sun which melts it all around, so that at last they rest on elevated pinnacles till they fall off by their weight, and in this manner those numerous pyramids are formed with which the surface is bristled. Throughout much of the length of a glacier the winter's snow melts from its surface as completely as it does from the ground; it is fed from above, for in the upper part the snow never melts, but accumulates in a stratified form and is consolidated. In some of the largest glaciers, where there is a difference of 4000 feet in height between the origin and termination, the pressure is enormous and irresistible, carrying all before it; even the thickest forest is overwhelmed and crushed.

Glaciers advance or retreat according to the severity or mildness of the season; they have been advancing in Switzerland of late years, but they are subject to cycles of unknown duration. From the moraines, as well as the striæ engraven on the rocks over which they have passed, M. Agassiz has ascertained that the valley of Chamouni was at one time occupied by a glacier that had moved towards the Col de Balme. A moraine 2000 feet above the Rhone at St. Maurice would appear to indicate that, at a remote period, glaciers had covered Switzerland to the height of 2155 feet above the Lake of Geneva.

Their increase is now limited by various circumstances—as the mean temperature of the earth, which is always above the freezing-point in those latitudes; excessive evaporation; and blasts of hot air, which occur at all heights, in the night as well as in the day, from some unknown cause. They are not peculiar to the Alps, but have been observed also in the glaciers of the Andes. From the heat of the valley thawing the ice, the natural springs that rise under the glacier as they do elsewhere, the heat of the earth, the melting of the glacier itself, the

rain that falls on its surface, which rushes down its crevices, a stream of turbid water is formed which works out an icy cavern at the termination of the glacier and flows through it into the lower ground. Thus, a glacier “begins in the clouds, is formed by the mountains, and ends in the ocean.”[23]

Granite no doubt forms the base of the mountain system of Eastern Europe, though it more rarely comes into view than might have been expected. Crystalline schists of various kinds are enormously developed, and generally form the most elevated pinnacles of the Alpine crest and its offsets, and also the principal chains in Greece and Turkey in Europe; but the secondary fossiliferous strata constitute the chief mass, and often rise to the highest summits; indeed, secondary limestones occupy a great portion of the high land of Eastern Europe. Calcareous rocks form two great mountain-zones on each side of the central chain of the Alps, and rise occasionally to altitudes of 10,000 or 12,000 feet. They constitute a great portion of the central range of the Apennines, and fill the greater part of Sicily. They are extensively developed in Turkey in Europe, where the plateau of Bosnia with its high lands on the south, part of Macedonia, and Albania with its islands, are principally composed of them.[24] Tertiary strata of great thickness rest on the flanks of the Alps, and rise in some places to a height of 5000 feet; zones of the older Pleiocene period flank the Apennines on each side, filled with organic remains; and half of Sicily is covered with the Pleiocene strata. It appears that the Atlas, the Sierra Morena and most of the Spanish mountains, the central chain of the Caucasus, and the Balkan, were raised before the period of the erratic blocks.

From numerous dislocations in the strata, the Alps appear to have been heaved up by many violent and repeated convulsions, separated by intervals of repose, and different parts of the chain have been raised at different times; for example, the Maritime Alps and the south-western part of the Jura mountains were raised previously to the formation of the chalk: but the tertiary period appears to have been that of the greatest commotions; for nearly two-thirds of the lands of Europe have risen since the beginning of that epoch, and those that existed then acquired additional height, though some sank below their original level. During that time the Alps acquired an additional elevation of between 2000 and 3000 feet; Mont Blanc then attained its present altitude; the Apennines rose 1000 or 2000 feet higher; and the Carpathians seem to have gained an accession of height since the seas were inhabited by the existing species of animals.[25]

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A WORLD IS BORN

by

LEIGH BRACKETT

(Transcriber's Note:

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pp. 56-70. Extensive research did not uncover any evidence
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The first ripples of blue fire touched Dio's men. Bolts of it fastened on gun-butts, and knuckles. Men screamed and fell. Jill cried out as he tore silver ornaments from her dress.

Mel Gray flung down his hoe with a sudden tigerish fierceness and stood erect. Tom Ward, working beside him, glanced at Gray's Indianesque profile, the youth of it hardened by war and the hells of the Eros prison blocks.

A quick flash of satisfaction crossed Ward's dark eyes. Then he grinned and said mockingly.

"Hell of a place to spend the rest of your life, ain't it?"

Mel Gray stared with slitted blue eyes down the valley. The huge sun of Mercury seared his naked body. Sweat channeled the dust on his skin. His throat ached with thirst. And the bitter landscape mocked him more than Wade's dark face.

"The rest of my life," he repeated softly. "The rest of my life!"

He was twenty-eight.

Wade spat in the damp black earth. "You ought to be glad--helping the unfortunate, building a haven for the derelict...."

"Shut up!" Fury rose in Gray, hotter than the boiling springs that ran from the Sunside to water the valleys. He hated Mercury. He hated John Moulton and his daughter Jill, who had conceived this plan of building a new world for the destitute and desperate veterans of the Second Interplanetary War.

"I've had enough 'unselfish service'," he whispered. "I'm serving myself from now on."

Escape. That was all he wanted. Escape from these stifling valleys, from the snarl of the wind in the barren crags that towered higher than Everest into airless space. Escape from the surveillance of the twenty guards, the forced companionship of the ninety-nine other veteran-convicts.

Wade poked at the furrows between the sturdy hybrid tubers. "It ain't possible, kid. Not even for 'Duke' Gray, the 'light-fingered genius who held the Interstellar Police at a standstill for five years'." He laughed. "I read your publicity."

Gray stroked slow, earth-stained fingers over his sleek cap of yellow hair. "You think so?" he asked softly.

Dio the Martian came down the furrow, his lean, wiry figure silhouetted against the upper panorama of the valley; the neat rows of vegetables and the green riot of Venusian wheat, dotted with toiling men and their friendly guards.

Dio's green, narrowed eyes studied Gray's hard face.

"What's the matter, Gray? Trying to start something?"

"Suppose I were?" asked Gray silkily. Dio was the unofficial leader of the convict-veterans. There was about his thin body and hatchet face some of the grim determination that had made the Martians cling to their dying world and bring life to it again.

"You volunteered, like the rest of us," said the Martian. "Haven't you the guts to stick it?"

"The hell I volunteered! The IPA sent me. And what's it to you?"

"Only this." Dio's green eyes were slitted and ugly. "You've only been here a month. The rest of us came nearly a year ago--because we wanted to. We've worked like slaves, because we wanted to. In three weeks the crops will be in. The Moulton Project will be self-supporting. Moulton will get his permanent charter, and we'll be on our way.

"There are ninety-nine of us, Gray, who want the Moulton Project to succeed. We know that that louse Caron of Mars doesn't want it to, since pitchblende was discovered. We don't know whether you're working for him or not, but you're a troublemaker.

"There isn't to be any trouble, Gray. We're not giving the Interplanetary Prison Authority any excuse to revoke its decision and give Caron of Mars a free hand here. We'll see to anyone who tries it. Understand?"

* * * * *

Mel Gray took one slow step forward, but Ward's sharp, "Stow it! A guard," stopped him. The Martian worked back up the furrow. The guard, reassured, strolled back up the valley, squinting at the jagged streak of pale-grey sky that was going black as low clouds formed, only a few hundred feet above the copper cables that ran from cliff to cliff high over their heads.

"Another storm," growled Ward. "It gets worse as Mercury enters perihelion. Lovely world, ain't it?"

"Why did you volunteer?" asked Gray, picking up his hoe.

Ward shrugged. "I had my reasons."

Gray voiced the question that had troubled him since his transfer.

"There were hundreds on the waiting list to replace the man who died. Why did they send me, instead?"

"Some fool blunder," said Ward carelessly. And then, in the same casual tone, "You mean it, about escaping?"

Gray stared at him. "What's it to you?"

Ward moved closer. "I can help you?"

A stab of mingled hope and wary suspicion transfixed Gray's heart. Ward's dark face grinned briefly into his, with a flash of secretive black eyes, and Gray was conscious of distrust.

"What do you mean, help me?"

Dio was working closer, watching them. The first growl of thunder rattled against the cliff faces. It was dark now, the pink flames of the Dark-side aurora visible beyond the valley mouth.

"I've got--connections," returned Ward cryptically. "Interested?"

Gray hesitated. There was too much he couldn't understand. Moreover, he was a lone wolf. Had been since the Second Interplanetary War wrenched him from the quiet backwater of his country home an eternity of eight years before and hammered him into hardness--a cynic who trusted nobody and nothing but Mel 'Duke' Gray.

"If you have connections," he said slowly, "why don't you use 'em yourself?"

"I got my reasons." Again that secretive grin. "But it's no hide off you, is it? All you want is to get away."

That was true. It would do no harm to hear what Ward had to say.

Lightning burst overhead, streaking down to be caught and grounded by the copper cables. The livid flare showed Dio's face, hard with worry and determination. Gray nodded.

"Tonight, then," whispered Ward. "In the barracks."

* * * * *

Out from the cleft where Mel Gray worked, across the flat plain of rock stripped naked by the wind that raved across it, lay the deep valley that sheltered the heart of the Moulton Project.

Hot springs joined to form a steaming river. Vegetation grew savagely under the huge sun. The air, kept at almost constant temperature by the blanketing effect of the hot springs, was stagnant and heavy.

But up above, high over the copper cables that crossed every valley where men ventured, the eternal wind of Mercury screamed and snarled between the naked cliffs.

Three concrete domes crouched on the valley floor, housing barracks, tool-shops, kitchens, store-houses, and executive quarters, connected by underground passages. Beside the smallest dome, joined to it by a heavily barred tunnel, was an insulated hangar, containing the only space ship on Mercury.

In the small dome, John Moulton leaned back from a pile of reports, took a pinch of Martian snuff, sneezed lustily, and said.

"Jill, I think we've done it."

The grey-eyed, black-haired young woman turned from the quartzite window through which she had been watching the gathering storm overhead. The thunder from other valleys reached them as a dim barrage which, at this time of Mercury's year, was never still.

"I don't know," she said. "It seems that nothing can happen now, and yet.... It's been too easy."

"Easy!" snorted Moulton. "We've broken our backs fighting these valleys. And our nerves, fighting time. But we've licked 'em!"

He rose, shaggy grey hair tousled, grey eyes alight.

"I told the IPA those men weren't criminals. And I was right. They can't deny me the charter now. No matter how much Caron of Mars would like to get his claws on this radium."

He took Jill by the shoulders and shook her, laughing.

"Three weeks, girl, that's all. First crops ready for harvest, first pay-ore coming out of the mines. In three weeks my permanent charter

will have to be granted, according to agreement, and then....

"Jill," he added solemnly, "we're seeing the birth of a world."

"That's what frightens me." Jill glanced upward as the first flare of lightning struck down, followed by a crash of thunder that shook the dome.

"So much can happen at a birth. I wish the three weeks were over!"

"Nonsense, girl! What could possibly happen?"

She looked at the copper cables, burning with the electricity running along them, and thought of the one hundred and twenty-two souls in that narrow Twilight Belt--with the fierce heat of the Sunside before them and the spatial cold of the Shadow side at their backs, fighting against wind and storm and heat to build a world to replace the ones the War had taken from them.

"So much could happen," she whispered. "An accident, an escape...."

The inter-dome telescreen buzzed its signal. Jill, caught in a queer mood of premonition, went to it.

The face of Dio the Martian appeared on the screen, still wet and dirty from the storm-soaked fields, disheveled from his battle across the plain in the chaotic winds.

"I want to see you, Miss Moulton," he said. "There's something funny I think you ought to know."

"Of course," said Jill, and met her father's eyes. "I think we'll see, now, which one of us is right."

* * * * *

The barracks were quiet, except for the mutter of distant thunder and the heavy breathing of exhausted men. Tom Ward crouched in the darkness by Mel Gray's bunk.

"You ain't gonna go soft at the last minute, are you?" he whispered. "Because I can't afford to take chances."

"Don't worry," Gray returned grimly. "What's your proposition?"

"I can give you the combination to the lock of the hangar passage. All you have to do is get into Moulton's office, where the passage door is, and go to it. The ship's a two-seater. You can get her out of the valley easy."

Gray's eyes narrowed in the dark. "What's the catch?"

"There ain't none. I swear it."

"Look, Ward. I'm no fool. Who's behind this, and why?"

"That don't make no difference. All you want ... _ow!_"

Gray's fingers had fastened like steel claws on his wrist.

"I get it, now," said Gray slowly. "That's why I was sent here. Somebody wanted me to make trouble for Moulton." His fingers tightened agonizingly, and his voice sank to a slow drawl.

"I don't like being a pawn in somebody else's chess game."

"Okay, okay! It ain't my fault. Lemme go." Ward rubbed his bruised wrist. "Sure, somebody--I ain't sayin' who--sent you here, knowin' you'd want to escape. I'm here to help you. You get free, I get paid, the Big Boy gets what he wants. Okay?"

Gray was silent, scowling in the darkness. Then he said.

"All right. I'll take a chance."

"Then listen. You tell Moulton you have a complaint. I'll...."

Light flooded the dark as the door clanged open. Ward leaped like a startled rabbit, but the light speared him, held him. Ward felt a pulse of excitement beat up in him.

The long ominous shadows of the guards raised elongated guns. The barracks stirred and muttered, like a vast aviary waking.

"Ward and Gray," said one of the guards. "Moulton wants you."

Gray rose from his bunk with the lithe, delicate grace of a cat. The monotony of sleep and labor was ended. Something had broken. Life was

once again a moving thing.

* * * * *

John Moulton sat behind the untidy desk. Dio the Martian sat grimly against the wall. There was a guard beside him, watching.

Mel Gray noted all this as he and Ward came in. But his cynical blue eyes went beyond, to a door with a ponderous combination lock. Then they were attracted by something else--the tall, slim figure standing against the black quartz panes of the far wall.

It was the first time he had seen Jill Moulton. She looked the perfect sober apostle of righteousness he'd learned to mock. And then he saw the soft cluster of black curls, the curve of her throat above the dark dress, the red lips that balanced her determined jaw and direct grey eyes.

Moulton spoke, his shaggy head hunched between his shoulders.

"Dio tells me that you, Gray, are not a volunteer."

"Tattletale," said Gray. He was gauging the distance to the hangar door, the positions of the guards, the time it would take to spin out the combination. And he knew he couldn't do it.

"What were you and Ward up to when the guards came?"

"I couldn't sleep," said Gray amiably. "He was telling me bedtime stories." Jill Moulton was lovely, he couldn't deny that. Lovely, but not soft. She gave him an idea.

Moulton's jaw clamped. "Cut the comedy, Gray. Are you working for Caron of Mars?"

Caron of Mars, chairman of the board of the Interplanetary Prison Authority. Dio had mentioned him. Gray smiled in understanding. Caron of Mars had sent him, Gray, to Mercury. Caron of Mars was helping him, through Ward, to escape. Caron of Mars wanted Mercury for his own purposes--and he could have it.

"In a manner of speaking, Mr. Moulton," he said gravely, "Caron of Mars is working for me."

He caught Ward's sharp hiss of remonstrance. Then Jill Moulton stepped forward.

"Perhaps he doesn't understand what he's doing, Father." Her eyes met Gray's. "You want to escape, don't you?"

Gray studied her, grinning as the slow rose flushed her skin, the corners of her mouth tightening with anger.

"Go on," he said. "You have a nice voice."

Her eyes narrowed, but she held her temper.

"You must know what that would mean, Gray. There are thousands of veterans in the prisons now. Their offenses are mostly trivial, but the Prison Authority can't let them go, because they have no jobs, no homes, no money.

"The valleys here are fertile. There are mines rich in copper and pitchblende. The men have a chance for a home and a job, a part in building a new world. We hope to make Mercury an independent, self-governing member of the League of Worlds."

"With the Moultons as rulers, of course," Gray murmured.

"If they want us," answered Jill, deliberately missing the point. "Do you think you have the right to destroy all we've worked for?"

Gray was silent. Rather grimly, she went on.

"Caron of Mars would like to see us defeated. He didn't care about Mercury before radium was discovered. But now he'd like to turn it into a prison mining community, with convict labor, leasing mine grants to corporations and cleaning up big fortunes for himself and his associates.

"Any trouble here will give him an excuse to say that we've failed, that the Project is a menace to the Solar System. If you try to escape, you wreck everything we've done. If you don't tell the truth, you may cost thousands of men their futures.

"Do you understand? Will you cooperate?"

Gray said evenly, "I'm my own keeper, now. My brother will have to take

care of himself."

It was ridiculously easy, she was so earnest, so close to him. He had a brief kaleidoscope of impressions--Ward's sullen bewilderment, Moulton's angry roar, Dio's jerky rise to his feet as the guards grabbed for their guns.

Then he had his hands around her slim, firm throat, her body pressed close to his, serving as a shield against bullets.

"Don't be rash," he told them all quietly. "I can break her neck quite easily, if I have to. Ward, unlock that door."

In utter silence, Ward darted over and began to spin the dial. At last he said, "Okay, c'mon."

Gray realized that he was sweating. Jill was like warm, rigid marble in his hands. And he had another idea.

"I'm going to take the girl as a hostage," he announced. "If I get safely away, she'll be turned loose, her health and virtue still intact. Good night."

The clang of the heavy door had a comforting sound behind them.

* * * * *

The ship was a commercial job, fairly slow but sturdy. Gray strapped Jill Moulton into one of the bucket seats in the control room and then checked the fuel and air gauges. The tanks were full.

"What about you?" he said to Ward. "You can't go back."

"Nah. I'll have to go with you. Warm her up, Duke, while I open the dome."

He darted out. Gray set the atmosphere motors idling. The dome slid open, showing the flicker of the auroras, where areas of intense heat and cold set up atmospheric tension by rapid fluctuation of adjoining air masses.

Mercury, cutting the vast magnetic field of the Sun in an eccentric orbit, tortured by the daily change from blistering heat to freezing cold in the thin atmosphere, was a powerful generator of electricity.

Ward didn't come back.

Swearing under his breath, tense for the sound of pursuit in spite of the girl, Gray went to look. Out beyond the hangar, he saw a figure running.

Running hard up into the narrowing cleft of the valley, where natural galleries in the rock of Mercury led to the places where the copper cables were anchored, and farther, into the unexplored mystery of the caves.

Gray scowled, his arrogant Roman profile hard against the flickering aurora. Then he slammed the lock shut.

The ship roared out into the tearing winds of the plain. Gray cut in his rockets and blasted up, into the airless dark among the high peaks.

Jill Moulton hadn't moved or spoken.

Gray snapped on the space radio, leaving his own screen dark. Presently he picked up signals in a code he didn't know.

"Listen," he said. "I knew there was some reason for Ward's running out on me."

His Indianesque face hardened. "So that's the game! They want to make trouble for you by letting me escape and then make themselves heroes by bringing me in, preferably dead.

"They've got ships waiting to get me as soon as I clear Mercury, and they're getting stand-by instructions from somebody on the ground. The somebody that Ward was making for."

Jill's breath made a small hiss. "Somebody's near the Project...."

Gray snapped on his transmitter.

"Duke Gray, calling all ships off Mercury. Will the flagship of your reception committee please come in?"

His screen flickered to life. A man's face appeared--the middle-aged, soft-fleshed, almost stickily innocent face of one of the Solar Systems greatest crusaders against vice and crime.

Jill Moulton gasped. "Caron of Mars!"

"Ward gave the game away," said Gray gently. "Too bad."

The face of Caron of Mars never changed expression. But behind those flesh-hooded eyes was a cunning brain, working at top speed.

"I have a passenger," Gray went on. "Miss Jill Moulton. I'm responsible for her safety, and I'd hate to have her inconvenienced."

The tip of a pale tongue flicked across Caron's pale lips.

"That is a pity," he said, with the intonation of a preaching minister. "But I cannot stop the machinery set in motion...."

"And besides," finished Gray acidly, "you think that if Jill Moulton dies with me, it'll break John Moulton so he won't fight you at all."

His lean hand poised on the switch.

"All right, you putrid flesh-tub. Try and catch us!"

The screen went dead. Gray hunched over the controls. If he could get past them, lose himself in the glare of the Sun....

He looked aside at the stony-faced girl beside him. She was studying him contemptuously out of hard gray eyes.

"How," she said slowly, "can you be such a callous swine?"

"Callous?" He controlled the quite unreasonable anger that rose in him. "Not at all. The war taught me that if I didn't look out for myself, no one would."

"And yet you must have started out a human being."

He laughed.

The ship burst into searing sunlight. The Sunside of Mercury blazed below them. Out toward the velvet dark of space the side of a waiting ship flashed burning silver.

Even as he watched, the flare of its rockets arced against the

blackness. They had been sighted.

Gray's practised eye gauged the stranger's speed against his own, and he cursed softly. Abruptly he wheeled the ship and started down again, cutting his rockets as the shadow swallowed them. The ship was eerily silent, dropping with a rising scream as the atmosphere touched the hull.

"What are you going to do?" asked Jill almost too quietly.

He didn't answer. Maneuvering the ship on velocity between those stupendous pinnacles took all his attention. Caron, at least, couldn't follow him in the dark without exhaust flares as guides.

They swept across the wind-torn plain, into the mouth of the valley where Gray had worked, braking hard to a stop under the cables.

"You might have got past them," said Jill.

"One chance in a hundred."

Her mouth twisted. "Afraid to take it?"

He smiled harshly. "I haven't yet reached the stage where I kill women. You'll be safe here--the men will find you in the morning. I'm going back, alone."

"Safe!" she said bitterly. "For what? No matter what happens, the Project is ruined."

"Don't worry," he told her brutally. "You'll find some other way to make a living."

Her eyes blazed. "You think that's all it means to us? Just money and power?" She whispered, "I hope they kill you, Duke Gray!"

* * * * *

He rose lazily and opened the air lock, then turned and freed her. And, sharply, the valley was bathed in a burst of light.

"Damn!" Gray picked up the sound of air motors overhead. "They must have had infra-red search beams. Well, that does it. We'll have to run for it, since this bus isn't armed."

With eerie irrelevancy, the teleradio buzzed. At this time of night, after the evening storms, some communication was possible.

Gray had a hunch. He opened the switch, and the face of John Moulton appeared on the screen. It was white and oddly still.

"Our guards saw your ship cross the plain," said Moulton quietly. "The men of the Project, led by Dio, are coming for you. I sent them, because I have decided that the life of my daughter is less important than the lives of many thousands of people.

"I appeal to you, Gray, to let her go. Her life won't save you. And it's very precious to me."

Caron's ship swept over, low above the cables, and the grinding concussion of a bomb lifted the ship, hurled it down with the stern end twisted to uselessness. The screen went dead.

Gray caught the half stunned girl. "I wish to heaven I could get rid of you!" he grated. "And I don't know why I don't!"

But she was with him when he set out down the valley, making for the cliff caves, up where the copper cables were anchored.

Caron's ship, a fast, small fighter, wheeled between the cliffs and turned back. Gray dropped flat, holding the girl down. Bombs pelted them with dirt and uprooted vegetables, started fires in the wheat. The pilot found a big enough break in the cables and came in for a landing.

Gray was up and running again. He knew the way into the explored galleries. From there on, it was anybody's guess.

Caron was brazen enough about it. The subtle way had failed. Now he was going all out. And he was really quite safe. With the broken cables to act as conductors, the first thunderstorm would obliterate all proof of his activities in this valley. Mercury, because of its high electrical potential, was cut off from communication with other worlds. Moulton, even if he had knowledge of what went on, could not send for help.

Gray wondered briefly what Caron intended to do in case he, Gray, made good his escape. That outpost in the main valley, for which Ward had been heading, wasn't kept for fun. Besides, Caron was too smart to have only one string to his bow.

Shouts, the spatter of shots around them. The narrow trail loomed above. Gray sent the girl scrambling up.

The sun burst up over the high peaks, leaving the black shadow of the valley still untouched. Caron's ship roared off. But six of its crew came after Gray and Jill Moulton.

* * * * *

The chill dark of the tunnel mouth swallowed them. Keeping right to avoid the great copper posts that held the cables, strung through holes drilled in the solid rock of the gallery's outer wall, Gray urged the girl along.

The cleft his hand was searching for opened. Drawing the girl inside, around a jutting shoulder, he stopped, listening.

Footsteps echoed outside, grew louder, swept by. There was no light. But the steps were too sure to have been made in the dark.

"Infra-red torches and goggles," Gray said tersely, "You see, but your quarry doesn't. Useful gadget. Come on."

"But where? What are you going to do?"

"Escape, girl. Remember? They smashed my ship. But there must be another one on Mercury. I'm going to find it."

"I don't understand."

"You probably never will. Here's where I leave you. That Martian Galahad will be along any minute. He'll take you home."

Her voice came soft and puzzled through the dark.

"I don't understand you, Gray. You wouldn't risk my life. Yet you're turning me loose, knowing that I might save you, knowing that I'll hunt you down if I can. I thought you were a hardened cynic."

"What makes you think I'm not?"

"If you were, you'd have kicked me out the waste tubs of the ship and gone on. You'd never have turned back."

"I told you," he said roughly, "I don't kill women." He turned away, but her harsh chuckle followed him.

"You're a fool, Gray. You've lost truth--and you aren't even true to your lie."

He paused, in swift anger. Voices the sound of running men, came up from the path. He broke into a silent run, following the dying echoes of Caron's men.

"Run, Gray!" cried Jill. "Because we're coming after you!"

The tunnels, ancient blowholes for the volcanic gases that had tortured Mercury with the raising of the titanic mountains, sprawled in a labyrinthine network through those same vast peaks. Only the galleries lying next the valleys had been explored. Man's habitation on Mercury had been too short.

Gray could hear Caron's men circling about through connecting tunnels, searching. It proved what he had already guessed. He was taking a desperate chance. But the way back was closed--and he was used to taking chances.

The geography of the district was clear in his mind--the valley he had just left and the main valley, forming an obtuse angle with the apex out on the wind-torn plain and a double range of mountains lying out between the sides of the triangle.

Somewhere there was a passage through those peaks. Somewhere there was a landing place, and ten to one there was a ship on it. Caron would never have left his men stranded, on the off chance that they might be discovered and used in evidence against him.

The men now hunting him knew their way through the tunnels, probably with the aid of markings that fluoresced under infra-red light. They were going to take him through, too.

They were coming closer. He waited far up in the main gallery, in the mouth of a side tunnel. Now, behind them, he could hear Dio's men. The noise of Caron's outfit stopped, then began again, softly.

Gray smiled, his sense of humor pleased. He tensed, waiting.

* * * * *

The rustle of cloth, the furtive creak of leather, the clink of metal equipment. Heavy breathing. Somebody whispered,

"Who the hell's that back there?"

"Must be men from the Project. We'd better hurry."

"We've got to find that damned Gray first," snapped the first voice grimly. "Caron'll burn us if we don't."

Gray counted six separate footsteps, trying to allow for the echoes. When he was sure the last man was by, he stepped out. The noise of Dio's hunt was growing--there must be a good many of them.

Covered by their own echoes, he stole up on the men ahead. His groping hand brushed gently against the clothing of the last man in the group. Gauging his distance swiftly, he went into action.

One hand fastened over the fellow's mouth. The other, holding a good-sized rock, struck down behind the ear. Gray eased the body down with scarcely a sound.

Their uniforms, he had noticed, were not too different from his prison garb. In a second he had stripped goggles, cap, and gun-belt from the body, and was striding after the others.

They moved like five eerie shadows now, in the queer light of the leader's lamp. Small fluorescent markings guided them. The last man grunted over his shoulder,

"What happened to you?"

"Stumbled," whispered Gray tersely, keeping his head down. A whisper is a good disguise for the voice. The other nodded.

"Don't straggle. No fun, getting lost in here."

The leader broke in. "We'll circle again. Be careful of that Project bunch--they'll be using ordinary light. And be quiet!"

They went, through connecting passages. The noise of Dio's party grew ominously loud. Abruptly, the leader swore.

"Caron or no Caron, he's gone. And we'd better go, too."

He turned off, down a different tunnel, and Gray heaved a sigh of relief, remembering the body he'd left in the open. For a time the noise of their pursuers grew remote. And then, suddenly, there was an echoing clamor of footsteps, and the glare of torches on the wall of a cross-passage ahead.

Voices came to Gray, distorted by the rock vaults.

"I'm sure I heard them, just then." It was Jill's voice.

"Yeah." That was Dio. "The trouble is, where?"

The footsteps halted. Then, "Let's try this passage. We don't want to get too far into this maze."

Caron's leader blasphemed softly and dodged into a side tunnel. The man next to Gray stumbled and cried out with pain as he struck the wall, and a shout rose behind them.

The leader broke into a run, twisting, turning, diving into the maze of smaller tunnels. The sounds of pursuit faded, were lost in the tomblike silence of the caves. One of the men laughed.

"We sure lost 'em!"

"Yeah," said the leader. "We lost 'em, all right." Gray caught the note of panic in his voice. "We lost the markers, too."

"You mean...?"

"Yeah. Turning off like that did it. Unless we can find that marked tunnel, we're sunk!"

Gray, silent in the shadows, laughed a bitter, ironic laugh.

* * * * *

They went on, stumbling down endless black halls, losing all track of branching corridors, straining to catch the first glint of saving light. Once or twice they caught the echoes of Dio's party, and knew that they, too, were lost and wandering.

Then, quite suddenly, they came out into a vast gallery, running like a subway tube straight to left and right. A wind tore down it, hot as a draught from the burning gates of Hell.

It was a moment before anyone grasped the significance of that wind. Then someone shouted,

"We're saved! All we have to do is walk against it!"

They turned left, almost running in the teeth of that searing blast. And Gray began to notice a peculiar thing.

The air was charged with electricity. His clothing stiffened and crackled. His hair crawled on his head. He could see the faint discharges of sparks from his companions.

Whether it was the effect of the charged air, or the reaction from the nervous strain of the past hours, Mel Gray began to be afraid.

Weary to exhaustion, they struggled on against the burning wind. And then they blundered out into a cave, huge as a cathedral, lighted by a queer, uncertain bluish light.

Gray caught the sharp smell of ozone. His whole body was tingling with electric tension. The bluish light seemed to be in indeterminate lumps scattered over the rocky floor. The rush of the wind under that tremendous vault was terrifying.

They stopped, Gray keeping to the background. Now was the time to evade his unconscious helpers. The moment they reached daylight, he'd be discovered.

Soft-footed as a cat, he was already hidden among the heavy shadows of the fluted walls when, he heard the voices.

They came from off to the right, a confused shout of men under fearful strain, growing louder and louder, underscored with the tramp of footsteps. Lights blazed suddenly in the cathedral dark, and from the mouth of a great tunnel some hundred yards away, the men of the Project poured into the cave.

And then, sharp and high and unexpected, a man screamed.

* * * * *

The lumps of blue light were moving. And a man had died. He lay on the rock, his flesh blackened jelly, with a rope of glowing light running from the metal of his gun butt to the metal buttons on his cap.

All across the vast floor of that cavern the slow, eerie ripple of motion grew. The scattered lumps melted and flowed together, converging in wavelets of blue flame upon the men.

The answer came to Gray. Those things were some form of energy-life, born of the tremendous electric tensions on Mercury. Like all electricity, they were attracted to metal.

In a sudden frenzy of motion, he ripped off his metal-framed goggles, his cap and gun-belt. The Moultons forbade metal because of the danger of lightning, and his boots were made of rubber, so he felt reasonably safe, but a tense fear ran in prickling waves across his skin.

Guns began to bark, their feeble thunder all but drowned in the vast rush of the wind. Bullets struck the oncoming waves of light with no more effect than the eruption of a shower of sparks. Gray's attention, somehow, was riveted on Jill, standing with Dio at the head of her men.

She wore ordinary light slippers, having been dressed only for indoors. And there were silver ornaments at waist and throat.

He might have escaped, then, quite unnoticed. Instead, for a reason even he couldn't understand, he ran for Jill Moulton.

The first ripples of blue fire touched the ranks of Dio's men. Bolts of it leaped upward to fasten upon gun-butts and the buckles of the cartridge belts. Men screamed, fell, and died.

An arm of the fire licked out, driving in behind Dio and the girl. The guns of Caron's four remaining men were silent, now.

Gray leaped over that hissing electric surf, running toward Jill. A hungry worm of light reared up, searching for Dio's gun. Gray's hand swept it down, to be instantly buried in a mass of glowing ropes. Dio's hatchet face snarled at him in startled anger.

Jill cried out as Gray tore the silver ornaments from her dress. "Throw down the guns!" he yelled. "It's metal they want!"

He heard his name shouted by men torn momentarily from their own terror. Dio cried, "Shoot him!" A few bullets whined past, but their immediate fear spoiled both aim and attention.

Gray caught up Jill and began to run, toward the tube from which the wind howled in the cave. Behind him, grimly, Dio followed.

The electric beasts didn't notice him. His insulated feet trampled through them, buried to the ankle in living flame, feeling queer tenuous bodies break and reform.

The wind met them like a physical barrier at the tunnel mouth. Gray put Jill down. The wind strangled him. He tore off his coat and wrapped it over the girl's head, using his shirt over his own. Jill, her black curls whipped straight, tried to fight back past him, and he saw Dio coming, bent double against the wind.

He saw something else. Something that made him grab Jill and point, his flesh crawling with swift, cold dread.

* * * * *

The electric beasts had finished their pleasure. The dead were cinders on the rock. The living had run back into the tunnels. And now the blue sea of fire was flowing again, straight toward the place where they stood.

It was flowing fast, and Gray sensed an urgency, an impersonal haste, as though a command had been laid upon those living ropes of flame.

The first dim rumble of thunder rolled down the wind. Gripping Jill, Gray turned up the tunnel.

The wind, compressed in that narrow throat of rock, beat them blind and breathless, beat them to their bellies, to crawl. How long it took them, they never knew.

But Gray caught glimpses of Dio the Martian crawling behind them, and behind him again, the relentless flow of the fire-things.

They floundered out onto a rocky slope, fell away beneath the suck of the wind, and lay still, gasping. It was hot. Thunder crashed abruptly, and lightning flared between the cliffs.

Gray felt a contracting of the heart. There were no cables.

Then he saw it--the small, fast fighter flying below them on a flat plateau. A cave mouth beside it had been closed with a plastic door. The ship was the one that had followed them. He guessed at another one behind the protecting door.

Raking the tumbled blond hair out of his eyes, Gray got up.

Jill was still sitting, her black curls bowed between her hands. There wasn't much time, but Gray yielded to impulse. Pulling her head back by the silken hair, he kissed her.

"If you ever get tired of virtue, sweetheart, look me up." But somehow he wasn't grinning, and he ran down the slope.

He was almost to the open lock of the ship when things began to happen. Dio staggered out of the wind-tunnel and sagged down beside Jill. Then, abruptly, the big door opened.

Five men came out--one in pilot's costume, two in nondescript apparel, one in expensive business clothes, and the fifth in dark prison garb.

Gray recognized the last two. Caron of Mars and the errant Ward.

They were evidently on the verge of leaving. But they looked cheerful. Caron's sickly-sweet face all but oozed honey, and Ward was grinning his rat's grin.

Thunder banged and rolled among the rocks. Lightning flared in the cloudy murk. Gray saw the hull of a second ship beyond the door. Then the newcomers had seen him, and the two on the slope.

Guns ripped out of holsters. Gray's heart began to pound slowly. He, and Jill and Dio, were caught on that naked slope, with the flood of electric death at their backs.

His Indianesque face hardened. Bullets whined round him as he turned back up the slope, but he ran doubled over, putting all his hope in the tricky, uncertain light.

Jill and the Martian crouched stiffly, not knowing where to turn. A flare of lightning showed Gray the first of the firethings, flowing out

onto the ledge, hidden from the men below.

"Back into the cave!" he yelled. His urgent hand fairly lifted Dio. The Martian glared at him, then obeyed. Bullets snarled against the rock. The light was too bad for accurate shooting, but luck couldn't stay with them forever.

Gray glanced over his shoulder as they scrambled up on the ledge. Caron waited by his ship. Ward and the others were charging the slope. Gray's teeth gleamed in a cruel grin.

Sweeping Jill into his arms, he stepped into the lapping flow of fire. Dio swore viciously, but he followed. They started toward the cave mouth, staggering in the rush of the wind.

"For God's sake, don't fall," snapped Gray. "Here they come!"

The pilot and one of the nondescript men were the first over. They were into the river of fire before they knew, it, and then it was too late. One collapsed and was buried. The pilot fell backward, and then other man died under his body, of a broken neck.

Ward stopped. Gray could see his face, dark and hard and calculating. He studied Gray and Dio, and the dead men. He turned and looked back at Caron. Then, deliberately, he stripped off his gun belt, threw down his gun, and waded into the river.

Gray remembered, then, that Ward too wore rubber boots, and had no metal on him.

* * * * *

Ward came on, the glowing ropes sliding surf-like around his boots. Very carefully. Gray handed Jill to Dio.

"If I die too," he said, "there's only Caron down there. He's too fat to stop you."

Jill spoke, but he turned his back. He was suddenly confused, and it was almost pleasant to be able to lose his confusion in fighting. Ward had stopped some five feet away. Now he untied the length of tough cord that served him for a belt.

Gray nodded. Ward would try to throw a twist around his ankle and trip

him. Once his body touched those swarming creatures....

He tensed, watchfully. The rat's grin was set on Ward's dark face. The cord licked out.

But it caught Gray's throat instead of his ankle!

Ward laughed and braced himself. Cursing, Gray caught at the rope. But friction held it, and Ward pulled, hard. His face purpling, Gray could still commend Ward's strategy. In taking Gray off guard, he'd more than made up what he lost in point of leverage.

Letting his body go with the pull, Gray flung himself at Ward. Blood blinded him, his heart was pounding, but he thought he foresaw Ward's next move. He let himself be pulled almost within striking distance.

Then, as Ward stepped, aside, jerking the rope and thrusting out a tripping foot, Gray made a catlike shift of balance and bent over.

His hands almost touched that weird, flowing surf as they clasped Ward's boot. Throwing all his strength into the lift, he hurled Ward backward.

Ward screamed once and disappeared under the blue fire. Gray clawed the rope from his neck. And then, suddenly, the world began to sway under him. He knew he was falling.

Some one's hand caught him, held him up. Fighting down his vertigo as his breath came back, he saw that it was Jill.

"Why?" he gasped, but her answer was lost in a titanic roar of thunder. Lightning blasted down. Dio's voice reached him, thin and distant through the clamor.

"We'll be killed! These damn things will attract the bolts!"

It was true. All his work had been for nothing. Looking up into that low, angry sky, Gray knew he was going to die.

Quite irrelevantly, Jill's words in the tunnel came back to him. "You're a fool ... lost truth ... not true to lie!"

Now, in this moment, she couldn't lie to him. He caught her shoulders cruelly, trying to read her eyes.

Very faintly through the uproar, he heard her. "I'm sorry for you, Gray. Good man, gone to waste."

Dio stifled a scream. Thunder crashed between the sounding boards of the cliffs. Gray looked up.

A titanic bolt of lightning shot down, straight for them. The burning blue surf was agitated, sending up pseudopods uncannily like worshipping arms. The bolt struck.

The air reeked of ozone, but Gray felt no shock. There was a hiss, a vast stirring of creatures around him. The blue light glowed, purpled.

Another bolt struck down, and another, and still they were not dead. The fire-things had become a writhing, joyous tangle of tenuous bodies, glowing bright and brighter.

Stunned, incredulous, the three humans stood. The light was now an eye-searing violet. Static electricity tingled through them in eerie waves. But they were not burned.

"My God," whispered Gray. "They eat it. They eat lightning!"

Not daring to move, they stood watching that miracle of alien life, the feeding of living things on raw current. And when the last bolt had struck, the tide turned and rolled back down the wind-tunnel, a blinding river of living light.

Silently, the three humans went down the rocky slope to where Caron of Mars cowered in the silver ship. No bolt had come near it. And now Caron came to meet them.

His face was pasty with fear, but the old cunning still lurked in his eyes.

"Gray," he said. "I have an offer to make."

"Well?"

"You killed my pilot," said Caron suavely. "I can't fly, myself. Take me off, and I'll pay you anything you want."

"In bullets," retorted Gray. "You won't want witnesses to this."

"Circumstances force me. Physically, you have the advantage."

Jill's fingers caught his arm. "Don't, Gray! The Project...."

Caron faced her. "The Project is doomed in any case. My men carried out my secondary instructions. All the cables in your valley have been cut. There is a storm now ready to break.

"In fifteen minutes or so, everything will be destroyed, except the domes. Regrettable, but...." He shrugged.

Jill's temper blazed, choking her so that she could hardly speak.

"Look at him, Gray," she whispered. "That's what you're so proud of being. A cynic, who believes in nothing but himself. Look at him!"

Gray turned on her.

"Damn you!" he grated. "Do you expect me to believe you, with the world full of hypocrites like him?"

Her eyes stopped him. He remembered Moulton, pleading for her life. He remembered how she had looked back there at the tunnel, when they had been sure of death. Some of his assurance was shaken.

"Listen," he said harshly. "I can save your valley. There's a chance in a million of coming out alive. Will you die for what you believe in?"

She hesitated, just for a second. Then she looked at Dio and said, "Yes."

Gray turned. Almost lazily, his fist snapped up and took Caron on his flabby jaw.

"Take care of him, Dio," he grunted. Then he entered the ship, herding the white-faced girl before him.

* * * * *

The ship hurtled up into airless space, where the blinding sunlight lay in sharp shadows on the rock. Over the ridge and down again, with the Project hidden under a surf of storm-clouds.

Cutting in the air motors, Gray dropped. Black, bellowing darkness

swallowed them. Then he saw the valley, with the copper cables fallen, and the wheat already on fire in several places.

Flying with every bit of his skill, he sought the narrowest part of the valley and flipped over in a racking loop. The stern tubes hit rock. The nose slammed down on the opposite wall, wedging the ship by sheer weight.

Lightning gathered in a vast javelin and flamed down upon them. Jill flinched and caught her breath. The flame hissed along the hull and vanished into seared and blackened rock.

"Still willing to die for principle?" asked Gray brutally.

She glared at him. "Yes," she snapped. "But I hate having to die in your company!"

She looked down at the valley. Lightning struck with monotonous regularity on the hull, but the valley was untouched. Jill smiled, though her face was white, her body rigid with waiting.

It was the smile that did it. Gray looked at her, her tousled black curls, the lithe young curves of throat and breast. He leaned back in his seat, scowling out at the storm.

"Relax," he said. "You aren't going to die."

She turned on him, not daring to speak. He went on, slowly.

"The only chance you took was in the landing. We're acting as lightning rod for the whole valley, being the highest and best conductor. But, as a man named Faraday proved, the charge resides on the surface of the conductor. We're perfectly safe."

"How dared you!" she whispered.

He faced her, almost angrily.

"You knocked the props out from under my philosophy. I've had enough hypocritical eyewash. I had to prove you. Well, I have."

She was quiet for some time. Then she said, "I understand, Duke. I'm glad. And now what, for you?"

He shrugged wryly.

"I don't know. I can still take Caron's other ship and escape. But I don't think I want to. I think perhaps I'll stick around and give virtue another whirl."

Smoothing back his sleek fair hair, he shot her a sparkling look from under his hands.

"I won't," he added softly, "even mind going to Sunday School, if you were the teacher."

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Image sources:

Description

English: An artist's rendition of the Phoenix Mars probe during landing. The sophisticated landing system on Phoenix allows the spacecraft to touch down within 10 kilometres (6.2 mi) of the targeted landing area. Thrusters are started when the lander is 570 metres (1,870 ft) above the surface. The navigation system is capable of detecting and avoiding hazards on the surface of Mars.

Date 2007

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Description

"PASSENGER PIGEON (*Columba Migratoria*) / Upper bird, female; lower, male /
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Date 1840

Lithograph by J. T. Bowen after a painting by John James Audubon in Pennsylvania, 1824.

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Description

Elementary Physical Geography - River Valleys

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